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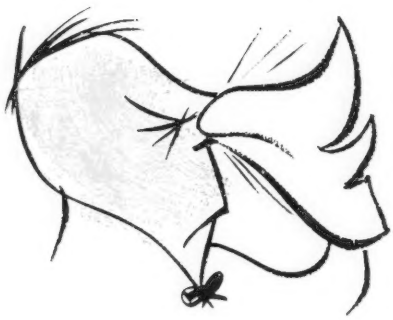

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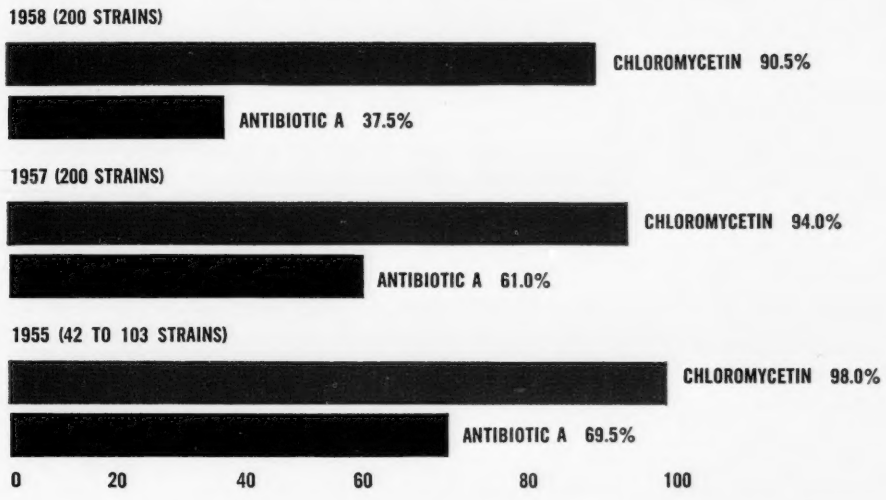

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The Industrial Medical Association was organized in 1915 as the American Association of Industrial Physicians and Surgeons. Its first annual meeting was held the following year. In 1951 the present name was adopted.

The purposes of the organization as stated in the certificate of incorporation (not-for-profit) are:

"The object of this Association will be to foster the study and discussion of the problems peculiar to industrial medicine and surgery; to develop methods adapted to the conservation of health among workers in the industries; to promote a more general understanding of the purposes of the medical care for employees; and to unite into one organization members of the medical profession specializing in industrial medicine and surgery for their mutual advancement in the practice of their profession."

Presently, the membership totals nearly 4000 physicians in the United States, Canada, Latin America, and other parts of the world. Physicians "who have an interest in Industrial Medicine" may apply for membership; specialization in this field is not essential. Regionally, the Industrial Medical Association has 14 Component Societies in the United States and one in Hawaii. Most Association members carry their membership through one of the component groups.

The Journal of Occupational Medicine, owned and published by the Industrial Medical Association, is sent monthly to each member as one of the advantages of membership.

The annual business meeting and convention is held in the spring. Since 1945, the convention has been held concurrently with the meetings of four other organizations having related interests—American Industrial Hygiene Association, American Conference of Governmental Industrial Hygienists, American Association of Industrial Nurses, Inc., American Association of Industrial Dentists. This combined meeting is known as the Industrial Health Conference.

The Occupational Health Institute, Inc., is a nonprofit educational organization created by the Industrial Medical Association to promote the cause of health in industry. Since 1951, the Occupational Health Institute has conducted the program of evaluation, approval and certification of Medical Services in Industry, on the basis of standards established by the Standards Committee of the Industrial Medical Association. This program was conducted by the American College of Surgeons for many years until its transfer to the Association.

The Association's headquarters office serves as a focal point for the Association's activities, and through its coordination of information regarding industrial health problems encountered throughout the country, it offers invaluable assistance to members on a host of specific subjects.

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An important function of the District Counselor is to serve in a liaison capacity with the Component Society of the Industrial Medical Association in his area. The District Counselor also is concerned with regional trends in industrial medical practice and in legislation bearing upon medical service in industry. He is ready to assist any physician with questions or problems.

In promoting the cause of industrial medicine, many District Counselors work with the industrial health committees of their state medical societies, they participate in teaching programs at hospitals or medical schools, and serve as speakers at meetings of groups that express interest in occupational health. Throughout these activities, the District Counselor attempts to stimulate membership in the Industrial Medical Association by acquainting others with the organization's purposes and facilities.

By keeping in close contact with members in his area, the District Counselor gains a familiarity with their work which enables him to make recommendations to the Association's officers and committees regarding those qualified for various positions or honors. He recommends members for committee work, and for fellowship, and recommends fellows for consideration for elective offices in the Association. He also recommends possible recipients for the awards presented at the annual meeting of the Association—the Knudsen Award, the Health Achievement in Industry Award, the Meritorious Service Award and the Merit in Authorship Award.

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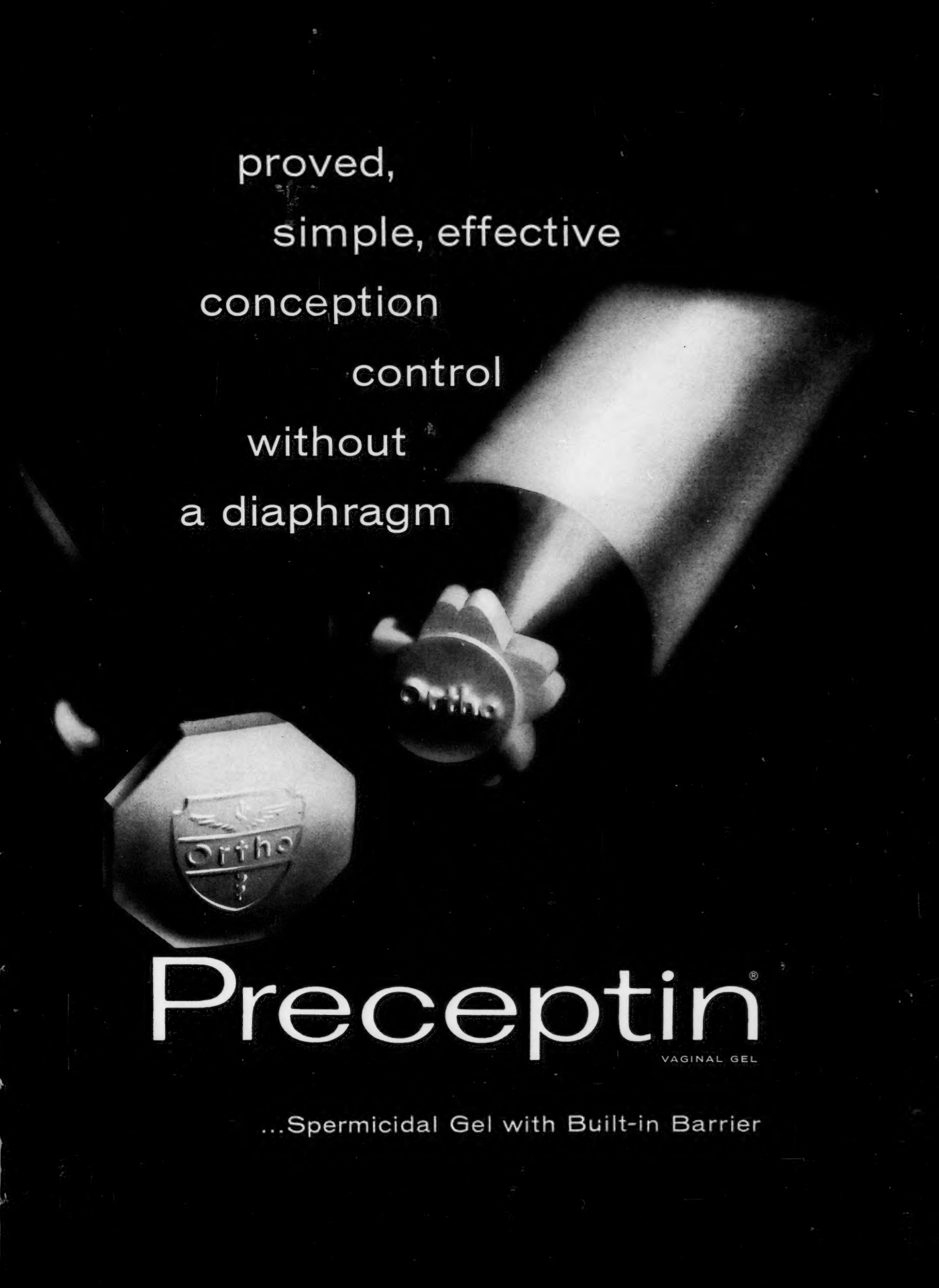
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Association Activities

OHI AWARDS CERTIFICATES OF HEALTH MAINTENANCE

MINIMAL STANDARDS
FOR ACCREDITATION
of the
OCCUPATIONAL HEALTH INSTITUTE
Prepared by the
Committee on Standards
INDUSTRIAL MEDICAL ASSOCIATION

1. The organization has a stated medical policy, including the following provisions: (a) Pre-placement medical examinations are performed; (b) Periodic medical examinations are performed on all employees who are exposed to special occupational hazards; (c) Voluntary periodic health inventories are encouraged. These examinations are conducted by a physician who is familiar with the specific work environment of the individual employee.

2. The professional staff is sufficient to carry out the above stated policy. Members of the medical and nursing staff are competent to perform the duties prescribed in the stated policy. They are graduates of accepted schools of learning; are in good standing; and licensed to practice in their respective states or provinces. They are worthy in character and in matters of professional ethics.

3. Suitable facilities are available for the performance of thorough pre-placement and periodic medical examinations.

4. A system of adequate and confidential records is maintained.

5. A competent consulting staff is maintained.

6. Sufficient attention is given to plant environment, i.e., sanitation, safety precautions, and industrial hygiene.

7. The medical director, medical adviser, or chief medical officer reports to some responsible member of management who is familiar with managerial interpretation of medical policy and whose assistance can be relied upon in implementing that policy.

8. In addition to facilities for pre-placement and periodic health inventories, a well equipped dispensary for emergency care is maintained.

Left to right: Clarence L. Lloyd, M.D., M. F. Mulville, M.D., Shirley Workman, R.N., Sherman Baker, M.D., and Gordon Petersen, M.D.

The Occupational Health Institute's Certificate of Health Maintenance recently was awarded to Kimberly-Clark Corporation, Fullerton, California, at a banquet attended by 60 persons, representing Company management, and the union's health and welfare committee. CLARENCE LEE LLOYD, M.D., regional consultant of OHI presented the award to T. W. HOWE, Mill Manager. G. W. PETERSON, M.D., Neenah, Wisconsin, is Medical Director for Kimberly-Clark Corporation. At the Fullerton plant, SHERMAN E. BAKER, M.D., is Assistant Medical Director, and is assisted by MAURICE F. MULVILLE, M.D., and SHIRLEY WORKMAN, R.N.

Left to right: R. C. Thompson, M.D., Alan C. Curtiss, and Robert W. Butler, M.D.

The Scovill Manufacturing Company, Waterbury, Connecticut, was awarded the Occupational Health Institute's Certificate of Health Maintenance on November 19, 1958, at Scovill Hospital. The presentation was made by R. C. THOMPSON, M.D., regional consultant of the OHI, to Scovill's Vice President ALAN C. CURTISS. In accepting the award, MR. CURTISS praised ROBERT W. BUTLER, M.D., Medical Director, and his staff of 15 members.

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High Quality Protein
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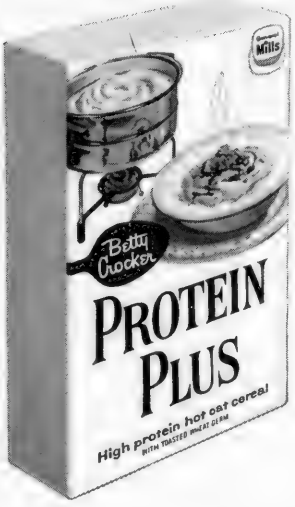
New Hot Cereal..

PROTEIN PLUS



When we have real news in the nutrition field, naturally we want the home economists of America to be sure to hear about it. Because you, perhaps more than any other group of people, influence the eating habits of the growing generation; teach them sound dietary principles; point to the foods which fullfil the requirements of these principles. And a well-known nutritionist has said that better nutrition during the first half of life will make for better health during the last half.

Protein Plus was developed by General Mills in response to a nutritional need. The need for a nourishing, protein-rich breakfast in America today is well-known. For this we have already created our ready-to-eat cereal, Hi-Pro. But many people, especially mothers, feel that a hot cereal is better for their families in cold weather. After months of research, *Protein Plus* is the result. Wherever it has been introduced it has met with a warm response. For you who are experts in the field . . . here is the background and scientific fact about our new hot cereal.

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1. *Protein Plus* is high quality protein cereal from toasted wheat germ and high protein fractions of the oat berry.

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7. *De luxe Packaging* . . . with a handy pouring spout that's so easy to use. There's real General Mills quality in this well-built box, beautifully designed and styled for today's family-living kitchens.

Journal of Occupational Medicine

SIDEROSIS

Additional observations over a period of eight years on sixty-nine foundry cleaning room employees

Lloyd E. Hamlin, M.D., Chicago

IN APRIL, 1950, the results of a study of 69 workers who had been exposed to foundry cleaning room dust for long periods of time were published in a paper by Hamlin and Weber.[1] Roentgenograms of the chests of these men disclosed pulmonary nodular shadows compatible with siderosis, but other investigations revealed no clinical signs or symptoms that might suggest impairment of the lungs. Industrial hygiene surveys of the working environment demonstrated exposure to dust containing high atmospheric concentrations of iron oxide and low amounts of free crystalline silica along with other minor constituents. The investigation was supported by experimental research conducted at the Saranac Laboratory, Saranac Lake, N. Y., on the pulmonary reaction following the inhalation of this dust by guinea pigs, rats, and rabbits over a space of three years. Examination of the workers, correlated with the data on hygiene and pathology, led to the conclusion that the nodular shadows which appeared in the roentgenograms of the lungs of these men represented principally siderosis and not silicosis, as is frequently claimed. It was pointed out by Vorwald[2] that, if the typical lesions of silicosis fail to appear in animals within a three-year period after they have been subjected to a high concentration of a variety of air-borne dusts, exposed industrial workers are not likely to develop silicosis during an entire working lifetime.

With this in mind, a review of the present health status of the 69 cleaning room employees seemed justified. The following information therefore is submitted after an additional period of eight years' observation to evaluate further this occupational health problem. Detailed reports are presented on nine individuals whose case histories were published in the original paper. Of the 69 cleaning room employees initially studied, 41 are still actively employed, as indicated in the table on the next page.

In the actively occupied group 10 men are working on extended employment. The normal retirement age in this particular company is 65 years, but employees are allowed to continue working if they wish on a year-to-year basis provided they are physically able to carry on with their jobs. They are required to have complete physical examinations each year before extensions are approved. Several of these persons are presently working on their sixth extension, either at their original jobs or in other suitable occupations.

Seventeen of the sixty-nine workers have retired, and all are alive. All are well except two,

Dr. Hamlin is Medical Director, American Brake Shoe Company.

Present Status of 69 Cleaning Room Employees Observed From 1949 to 1957

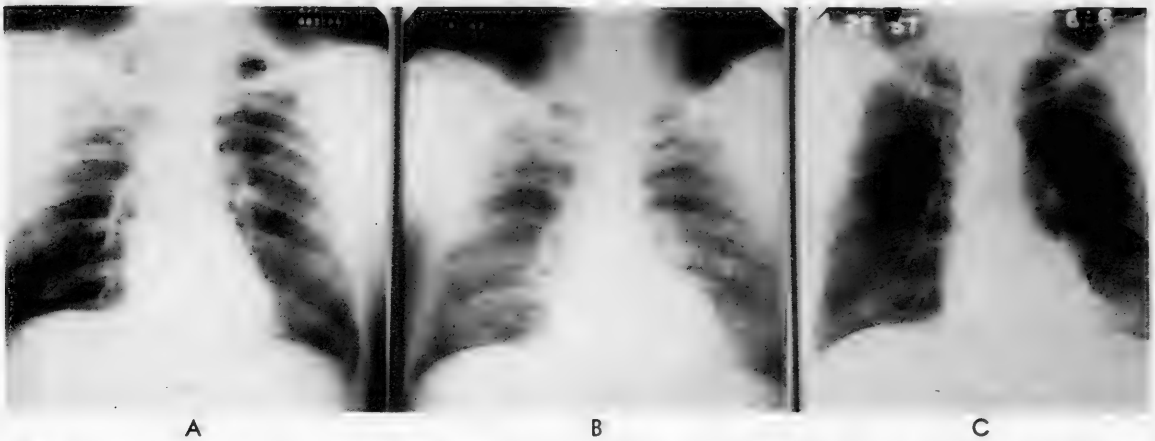
Number of men still working		41
At original jobs (grinding, burning, etc.)	28	
At comparable jobs (cleaning room, machine shop)	4	
At lighter nondusty jobs	5	
As foremen	4	
Number of men retired		17
Number of men who have terminated employment		5
Number of men who have died		5
Number of men absent because of pulmonary disease		1
		69

who were placed on special disability pensions because of cardiovascular disease. Eight members of this group are 72 years of age or over, and the ages of the remaining nine range from 63 to 71 years. Termination of employment for various reasons has occurred in five instances, and further contact with these men has been lost. Another workman (Case 6) is absent from work at the time of writing this report because of disease referable to his lungs. Five of the sixty-nine employees have died during the past eight years from causes unrelated to occupation. Of these, three suffered cerebral hemorrhages which proved fatal, one was killed in a motor car accident, and another died of hypertensive cardiovascular disease. The ages at death were 64, 66, 66, 67, and 68 respectively.

A study of the chest roentgenograms of the 69 employees was made, and it was noted that each employee has had at least one x-ray examination every year for the past eight years. A number have had additional films made during this period as check-up procedures. A majority of the serial films were reviewed in consultation with Dr. O. A. Sander, in order to confirm our own interpretations, and agreement was reached in practically every instance. Subsequent to the time the nodular pattern became fully established, little or no change was observed in the serial roentgenograms of 66 of the 69 cleaning room employees, except for cardiovascular alterations and slight differences compatible with advancing age. In the latest films of 3 of the 66 cases the nodular shadows appeared somewhat less pronounced, suggesting possible clearing of the radiological pattern, although the changes might have been due to variable x-raying techniques; at any rate they showed no definite progression.

In two of the three employees in whose roentgenograms recognizable changes were observed, these variations were not especially marked, but in the third they were unmistakable. One of the three, who retired in 1951, showed an increased shadow at the level of the second right interspace in his chest roentgenogram as far back as 1942. This was considered to be a focal lesion of tuberculosis. The man was under constant medical observation thereafter and underwent repeated x-ray and clinical examinations up to and including 1951. On his latest film in 1956, the shadow has remained stationary. He is now 72 years of age and continues to be active, working around his house and garden. Since this retired employee worked in coal mines for six years and performed considerable hard rock drilling, there is a possibility that this environment might have produced some of the changes observed in the roentgenogram. In our opinion, however, if silicosis is present it is not producing any great degree of disability. The second employee worked at his regular job of grinder in the cleaning room for 48 years up to October 1957 and was on his seventh extension of employment. He is now 72 years of age, and two months after recovering from bronchopneumonia, he underwent surgery for the removal of his gallbladder. He is apparently well and is planning to retire in the near future. His history (Case 2) is reviewed elsewhere in this report. The third worker (Case 6) shows considerable alteration in his roentgenographic pattern which is associated with an unusual type of infection caused by atypical chromogenic acid-fast bacilli. A detailed summary of the findings is given in the case history contained in this paper.

In reevaluation of the chest roentgenograms of five other employees selected from the entire group, it was observed that the findings were certainly suggestive of a fibrosis that might have resulted from a combination of dusts, such as iron and silica, but in no instance could a history of adequate exposure to free crystalline silica be confirmed. Two of these men are actively at work, one at his usual job of grinder and the other in the carpenter shop. The latter employee requested a transfer to this department a few years ago. Another man died in 1950 at the age of 66 of cerebral hemorrhage after he had retired at age 65. The remaining two workers have accepted retirement and are well according to the latest reports. It appears therefore that while the roentgenological picture in these five cases is compatible to some extent with that of siderosilicosis, the clinical course of the condition, together with the absence of adequate exposure to fibrogenic dust, arouses doubt as to the accuracy of such a



A B C

Fig. 1 (Case 1)—Serial roentgenograms taken in 1934 (A), 1947 (B), and 1957 (C). No further change is apparent in the nodular shadows over the last 10 years, and the healed infection in the right upper lobe remains stabilized.

diagnosis. The recent developments and pathology studies reported on Case No. 6 support this conclusion.

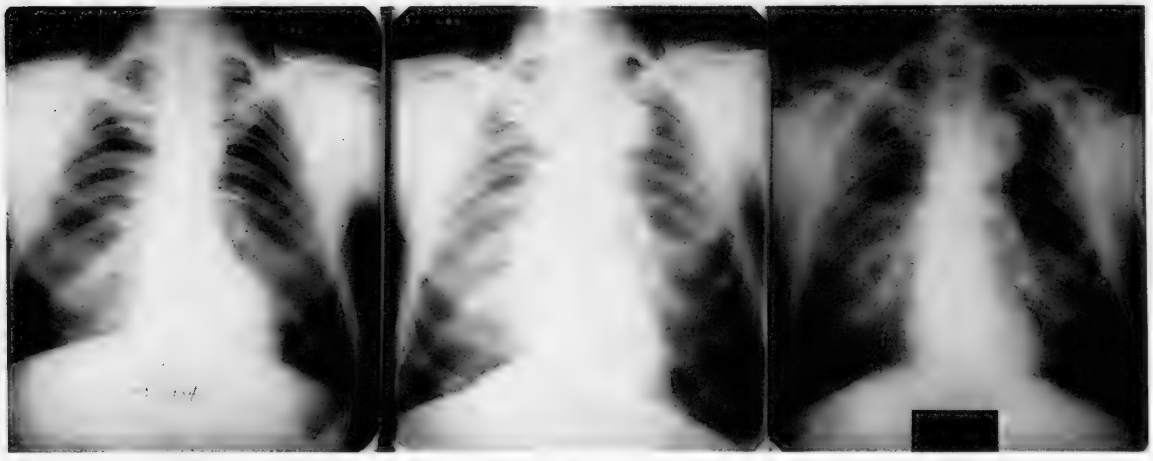
Report of Cases

CASE 1—The previous report covered this employee's history up to and including the year 1949. At that time he had completed 34 years service on the job of operating a large grinding lathe without any lost time except for two weeks in 1923 because of pleurisy. He retired on Sept. 1, 1956, at the age of 65, although an application for extended employment was approved; hence he had altogether 41 years of service at the same occupation. Serial chest roentgenograms from the years 1933 to 1949 revealed well-developed nodulation typical of siderosis. Infection, presumed to be tuberculous, appeared in the upper lobe of the right lung but healed, leaving only a fine linear scar with no further change in the nodular shadows. This occurred in spite of the fact that the man remained at his work under continual exposure to this particular industrial dust. Such a course of events was contrary to what might have been expected if the nodulation observed in the roentgenograms were due to silicosis. Additional chest roentgenograms were taken in 1950, 1951, 1953, 1954, 1955, 1956, and 1957, none of which showed any definite change from earlier films. The 1957 film suggested slight clearing of some of the shadows previously noted, but this was not positive.

Routine periodic physical examinations in 1952 and 1954 disclosed no complaints and no unusual findings. The employee did lose 13 weeks from work in July, 1951, because he elected to have a left inguinal hernioplasty, after which his weight dropped from 216 pounds to 209 pounds. His blood pressure was 134 systolic and 88 diastolic, and examination of the heart and lungs revealed no evidence of disease. He underwent a transurethral resection of the prostate in October, 1955, and periodically consults his urologist. His last health check-up was completed in April, 1956, at which time he had no symptoms or complaints. His weight has been reduced to 200 pounds, and his blood pressure was 146 systolic and 86 diastolic at the last reading. Examination of the heart and lungs was negative, and no other significant findings were recorded. At the last report he did not complain of any disability.

This employee accordingly has had serial chest roentgenograms over a period of 24 years from 1933 to 1957 without developing any particular progression of the nodular shadows noted in earlier films. The present state of affairs has prevailed in spite of the fact that he worked continuously at the same machine and under the same environmental conditions to the time he accepted retirement two years ago. The iron content of air samples from February, 1949, to September, 1955, taken in the working place ranged from 4 mg of iron oxide to 94 mg, with an average of 26 mg per cubic meter of air, as compared to a range of 14 to 84 mg, average 29 mg, reported in the original paper. Since the threshold limit for iron oxide fume is 15 mg of iron oxide per cubic meter of air (American Governmental Hygienist's Conference 1958), it would seem that the employee in this instance continued to be subjected to significant concentrations of iron oxide dust during the more recent period. The absence of progression of the nodular shadows in these circumstances and the lack of symptoms referable to the lungs provide additional confirmation of the original diagnosis.

CASE 2—The original report on this employee covered his employment for 40 years to 1949 as a grinder on rough manganese steel castings weighing from 500 to 10,000 pounds each. In his serial roentgenograms from 1933 to 1949 a shadow strongly suggestive of tuberculous infection remained unchanged over a period of 12 years, in spite of continual exposure to dust from the grinding operation and the fact that extensive nodular densities, interpreted as siderosis, were present throughout both lung fields. From 1949 to October, 1957, he continued to handle his work assignment without difficulty or complaint. The works manager of the plant stated that the employee was "just as good



A B C

Fig. 2 (Case 2)—Roentgenograms made in 1934 (A), 1948 (B), and 1958 (C). No definite changes are observed in this series of films over the last 10 years other than those that might be expected from cardiovascular alterations and advancing years. The focal area of infection in the left upper lobe is slightly larger and more sharply circumscribed.

as any young man" as far as job performance was concerned.

In October, 1957, he developed bronchopneumonia which resolved satisfactorily under treatment. He was able to return to work in December, but in the latter part of January, 1958, he was readmitted to hospital for gallbladder surgery. He made an uneventful recovery from the operation, and in April, 1958, stated that he had decided to accept retirement from active work. He is now 72 years old and has had seven annual extensions of employment beyond the usual retirement age of 65.

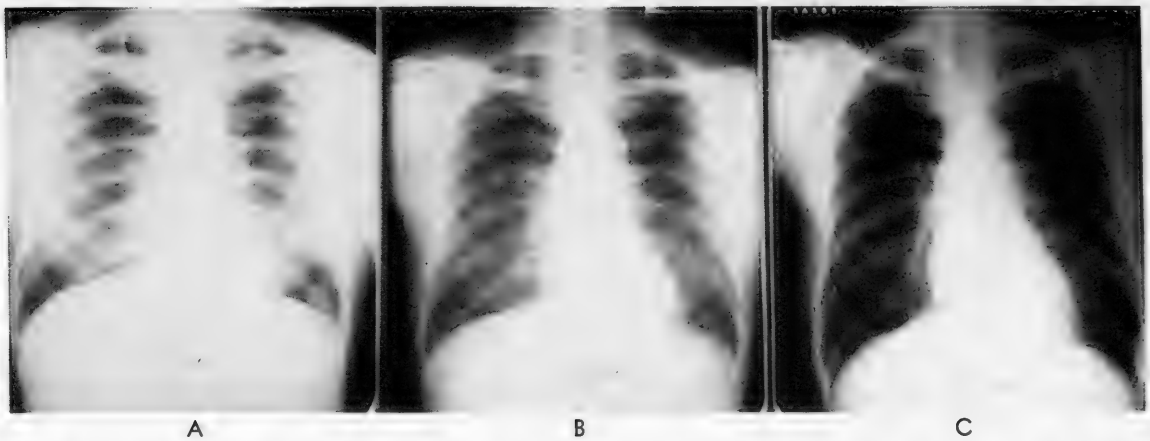
A review of his medical record indicates that, during the intervening years from the publication of the original report of his case in 1949 to the present, the employee had additional chest roentgenograms in 1950, 1951, 1953, 1954, 1955, 1956, 1957, and 1958. In the film made in 1951 the shadow previously interpreted as a focal area of tuberculosis in the left upper lobe appeared to be slightly larger. The radiograph of 1953 showed more calcification of the pleura in the right lower third of the lung but no further progression of the shadow in the left upper lobe or change in the nodular densities throughout the remainder of the lung fields.

Because there appeared to be some increase in the suspected focal area of tuberculosis in the 1954 roentgenogram, the man was advised to have further medical examination. The specialist in pulmonary disease to whom he was referred reported that the employee complained of slight cough and dyspnea on exertion such as walking upstairs rapidly, but not in performing his ordinary working activities. He also complained of some pain in his left lower chest and left upper abdomen, but the pain was not related to respiration or eating. The physical examination showed no important variations from normal except a slight decrease in breath sounds. His weight had dropped from 178 pounds in 1953 to 174 pounds in 1954. Guinea pig inoculation with gastric washings proved to be negative for tubercle bacilli, and repeated afternoon temperature checks for several months were normal. The pain seemed to localize in the abdomen, and constipation developed which cleared up after treatment.

Subsequent physical examinations in 1955, 1956, and 1957 disclosed no unusual findings except for the development of a left inguinal hernia which caused no inconvenience. An electrocardiogram made on Jan. 29, 1957, revealed findings consistent with a myocardial infarction of the posterior wall, probably old, and also premature ventricular contractions. Repeat electrocardiograms on Aug. 27, and Dec. 10, 1957, showed no further change. The latest chest roentgenogram, on March 21, 1958, does not differ specifically from earlier films, in spite of the fact that the employee had contracted a serious acute lung ailment (bronchopneumonia) a few months previously. The realization that he has made a good recovery following a cholecystectomy three months ago attests to the belief that his general health is not seriously affected by the occupational changes observed in his chest roentgenograms.

This man, accordingly, has worked for 47 years as a grinder in the same plant on the identical job. Up to the year 1949 concentrations of iron oxide in his working area were considered to be in the order of the general atmospheric samples taken in the cleaning room. These ranged from 14 to 224 mg of iron per cubic meter of air, with an average of 49 mg.

Since the previous review of his case in 1949 he has been exposed to dust concentrations ranging from 2 mg of iron per cubic meter of air to 26 mg, with an average of 14 mg per cubic meter of air. While his recent average exposure, therefore, has not been as high as in the earlier years, because of improvements in ventilation in the plant, the fact that a number of air samples showed fairly



A B C

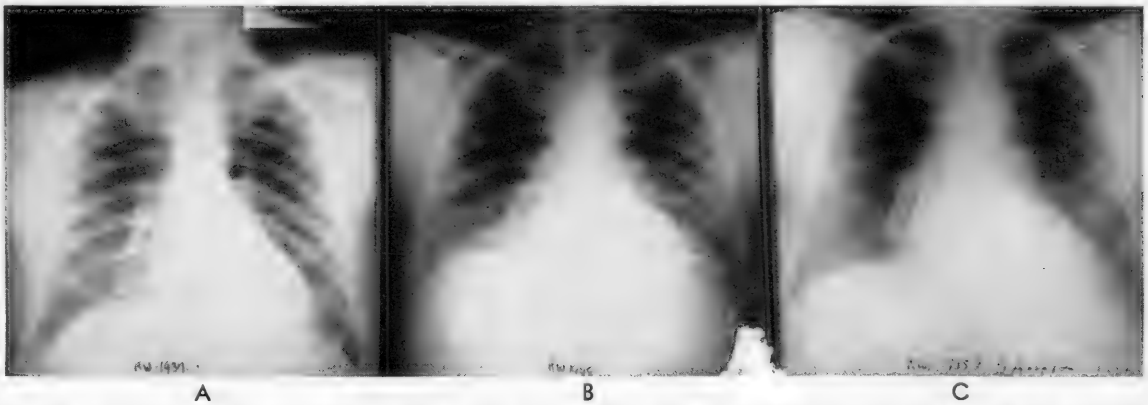
Fig. 3 (Case 3)—Serial roentgenograms show no change in pulmonary nodular shadows up to the year 1948 after 39 years' employment as a grinder on steel castings. This employee died of cerebral hemorrhage at age 67.

high values for iron oxide indicates that the exposure was not negligible. He has had serial chest roentgenograms from 1933 to 1958, a period of 25 years. This represents a chronological span from 47 to 72 years of age. As previously mentioned, up to October, 1957, the employee had no serious illnesses and worked continually at his regular job of swing frame grinding without loss of time or production and with an excellent safety record. An achievement of this kind is not consistent with the course of events in well-established silicosis. It does tend to confirm the conviction that the form of pneumoconiosis observed in the employee's chest roentgenograms is due to the deposition of radiopaque iron dust rather than free crystalline silica.

CASE 3—This employee was 63 years of age when his case was reported in 1949. He was then working as a janitor because of hypertensive heart disease and arteriosclerosis. While under treatment for this condition he suffered a severe heart attack which was diagnosed as auricular fibrillation. He was hospitalized and made a fair recovery. He retired on Dec. 27, 1950, at the age of 65, after 49 years 9 months of continual service. A chest roentgenogram made two months prior to retirement showed a more normal cardiac silhouette as a response to therapy, but otherwise there was no change in the pulmonary markings. The employee was not followed closely after retirement, since he was under the care of his personal physician. He died March 6, 1952, of cerebral hemorrhage, arteriosclerosis, and hypertensive heart disease. He had been employed almost 50 years in the same plant, 39 of these as a grinder on manganese steel castings. While roentgenological changes attributable to cardiovascular disease were present, the pulmonary nodular pattern showed no definite progression from 1949 to the time of his death three years later.

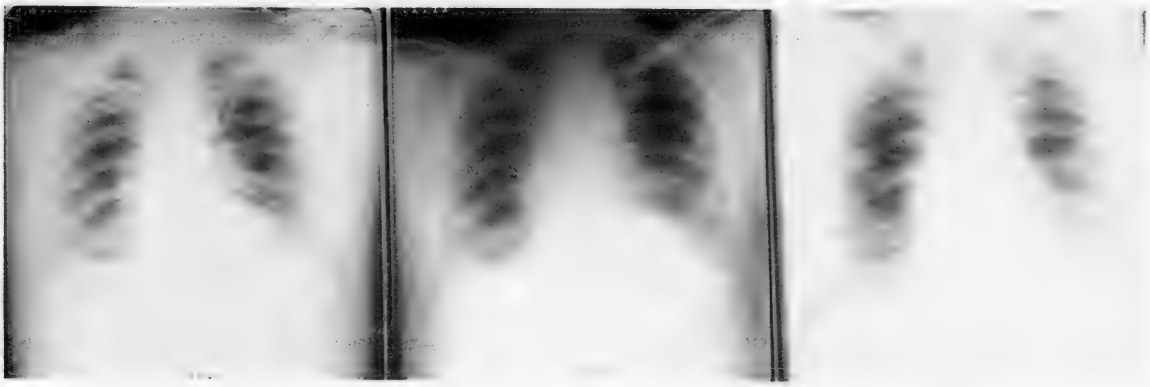
CASE 4—This employee developed a definite nodular pattern in his chest roentgenogram during a period of five years' exposure (1937 to 1942) to iron oxide from acetylene burning, but subsequent films showed no further change in the degree of siderosis.

The original review covered the case to 1949. At that time the man was 53 years of age and was a foreman in the cleaning room, a job he had held for three years following his nine years of employment as an acetylene burner. Since 1949



A B C

Fig. 4 (Case 4)—Serial roentgenograms made in 1937 (A), 1948 (B), and 1957 (C). Allowing for alterations due to cardiovascular disease, increased weight, and advancing years, no change is noted in the nodular pattern during the last nine years.



A B C

Fig. 5 (Case 5)—Roentgenograms made in 1934 (A), 1948 (B), and 1957 (C). When allowance is made for cardiovascular change, the employee's increased weight, and the rather poor quality of the 1957 film, no definite change has occurred in the nodular shadows in the last nine years.

he has had chest roentgenograms in 1950, 1951, 1953, 1954, 1955, 1956, and 1957. The employee has added 30 pounds to his weight since 1937; hence when allowance is made for this, along with cardiovascular alterations compatible with age and possible hypertensive heart disease, there appears to be no significant increase in the nodular shadows observed in his latest film.

A physical examination was performed in 1951, at which time he stated that his health was good. He had lost one week from work during the year because of colitis but suffered no other illness. His blood pressure was slightly higher (154 systolic and 100 diastolic as compared with 140 systolic and 90 diastolic in 1949). He weighed 215 pounds but otherwise was in good physical condition. Examination of the heart and lungs disclosed no significant increase of abnormalities, and an electrocardiogram revealed findings within normal limits.

Physical examinations performed in 1952, 1953, 1954, and 1955 revealed no marked change from the disclosures previously noted. Electrocardiographic findings on each occasion were within normal limits. In 1956 the employee was reexamined, although he had no complaints and had lost no time through illness. Examination of his heart, however, revealed a faint systolic murmur over the aortic area which was transmitted toward the left side of the chest. The pulse rate was 72 per minute at rest, 90 after exercise, and 72 two minutes later; and rhythm and quality were good. The systolic blood pressure was 158 and the diastolic 100. Examination of the lungs revealed no significant changes, and the chest roentgenogram showed no new developments.

The employee is now 64 years of age and is carrying on his regular duties as foreman in the cleaning room without complaint. He has reduced his weight to 190 pounds, and his blood pressure has dropped to 126 systolic and 86 diastolic. He has had serial chest roentgenograms over a period of 20 years (1937 to 1957) at the same plant. During this time he has never complained of any respiratory ailment or distress, nor has there been any appreciable change in the nodular shadows since they first became apparent in his x-ray film of 1942. His exposure to iron oxide during the eight years 1949 to 1957 ranged from less than 1 mg of iron per cubic meter of air to 6 mg, with an average of less than 1 mg. These ranges reflect improved working conditions in this plant due to the installation of exhaust ventilation equipment. Average concentrations of iron oxide as originally reported were in the range of 95 mg of iron per cubic meter of air at the burning stations.

CASE 5—As previously reported, this man operated a stiff shaft grinder for 32 years (1914 to 1946) but also had some experience as an acetylene burner. He was a welder for seven years in another industry before he began his present employment. In 1947 he was given a job as watchman in the yard at his own request. X-ray examination of his chest in 1933 indicated a nodular pattern which became more distinct by 1946, but no further changes were observed. He had additional chest roentgenograms in 1950, 1951, 1953, 1954, 1955, 1956, and 1957. The latest film showed more accentuated pulmonary markings, but, allowing for cardiovascular alterations and added years, no apparent change or progression of nodulation was evident. The employee's weight increased from 185 pounds in 1933 to 196 pounds in 1957.

A periodic physical examination performed on Oct. 12, 1953, revealed the fact that the man complained of shortness of breath on walking rather fast. He suffered from insomnia but maintained that he was in good health. He was considered to be a heavy drinker, but apparently his drinking never interfered seriously with his work. His blood pressure was 190 systolic and 102 diastolic in 1949. The electrocardiogram in 1949 showed only minor conduction variations which were not considered excessive for age. The heart findings were normal except for a "snappy" aortic second sound. Examination of the lungs revealed no significant changes. The employee was advised to place himself under medical care because of his hypertension, but he did not follow this recommendation.

Subsequent physical examinations in 1954, 1955,

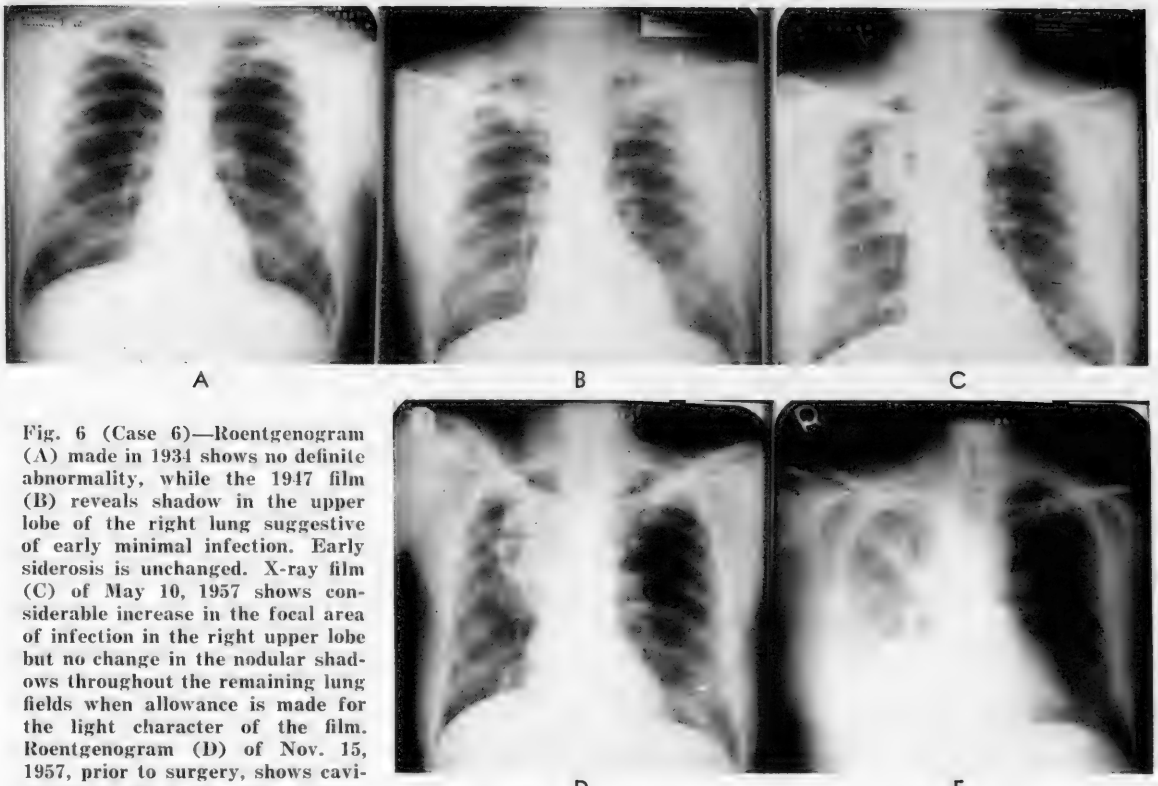


Fig. 6 (Case 6)—Roentgenogram (A) made in 1934 shows no definite abnormality, while the 1947 film (B) reveals shadow in the upper lobe of the right lung suggestive of early minimal infection. Early siderosis is unchanged. X-ray film (C) of May 10, 1957 shows considerable increase in the focal area of infection in the right upper lobe but no change in the nodular shadows throughout the remaining lung fields when allowance is made for the light character of the film. Roentgenogram (D) of Nov. 15, 1957, prior to surgery, shows cavitation of the focal area of infection with no further change in the nodulation. Film (E) of Dec. 17, 1957, shows results of upper right lobectomy with no alteration of the nodular pattern elsewhere in the lungs.

1956, and 1957 revealed no marked change in the cardiac findings, and examination of the lungs disclosed no progression of nodular markings in spite of the fact that he had lost two weeks' time from work during the past year because of influenza; he had also gained 12 pounds since his previous health check-up. His latest electrocardiogram, on Feb. 5, 1957, showed some evidence of myocardial damage, but findings otherwise were within normal limits.

This man, who is currently working on his second extension of employment, is now going on 67 years of age. Over a period of 23 years, the last 9 of which were spent as a watchman, he has had 17 chest roentgenograms. There has been no noticeable change in the roentgenographic nodular pattern since it was first observed, 23 years ago, except those alterations which might be compatible with advancing years and possibly cardiovascular disease. The employee does not cooperate in remaining under medical care, but he does not complain of dyspnea or other symptoms. He has no difficulty performing his job of watchman, although considerable walking and climbing of stairs are involved. Such findings are not consistent with the pulmonary radiological changes observed if these are the result of contact with free crystalline silica. They *are* compatible with those produced by the deposition of iron oxide in pulmonary tissue.

CASE 6—In the original presentation it was pointed out that this employee had worked as a grinder on manganese steel castings for a period of six years and also as a chipper for four years before becoming a crane operator in the cleaning room. A definite nodular pattern first noted in his chest roentgenogram in 1942 remained unchanged in 1949.

The man is now 58 years of age, and on Oct. 14, 1957, was still working at his regular job of crane operator in the cleaning room. He did not complain of illness during this time and stated that he felt well. He was able to perform his duties without difficulty, and management considered his work to be quite satisfactory. Recently however, he became ill with what was diagnosed as pneumonia and was admitted to a hospital for treatment. The case report as presented in our previous publication covered his history briefly to 1949, but because of subsequent interesting developments it is reviewed herewith in considerable detail.

The employee was born in the year 1900 in Mexico. From 1919 to 1923 he worked at various jobs and then accepted a position as a chipper-grinder at the plant where he is now located. He was laid off in 1927 and obtained employment for a year as an engineer helper for a railroad company. He came back to the plant in 1929 for 10 months as a grinder before being laid off again because of lack of work. He then mined coal for three years to 1932, after which he became a laborer on WPA

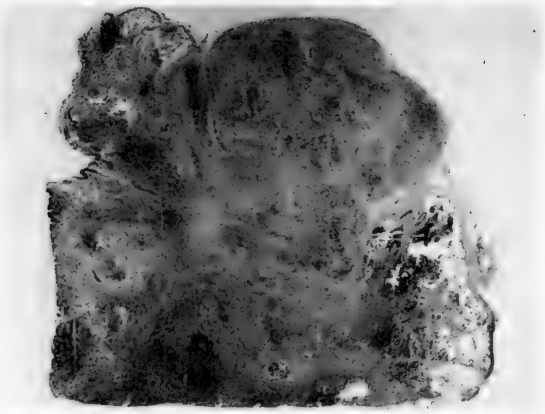


Fig. 7* (Case 6)—Section of right upper lobe, posteriorly, which depicts the conglomerate mass of fibrous tissue. The pulmonary architecture is generally obliterated, except for peripheral segments which reveal emphysematous changes. Magnification × 2.

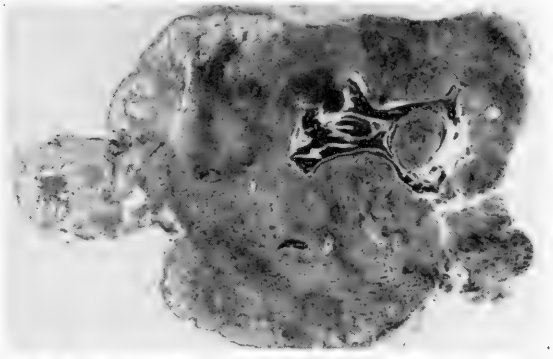


Fig. 8* (Case 6)—Section of right upper lobe, anteriorly. Except for the peripheral zone of emphysematous tissue, the pulmonary parenchyma is obliterated by a mass of fibrous tissue which surrounds an elongated irregular cavity. The latter contains extravasated blood and segments of pigmented fibrous tissue. Reduced about one fourth from magnification × 2.

projects and then a butcher in a packing plant. He returned to his job of grinding in 1936 and was so employed in June, 1938, when economic conditions necessitated a lay-off. In 1939 he was once more reinstated at his work of grinding and chipping and remained in that capacity until 1949. Since 1949 he has been operating a crane in the cleaning room. His exposure to cleaning room dust therefore covered a period of 17 years as a grinder and 8 years as a crane operator, a total of 25 years. The dust exposure over the three year period of coal mining is not known, but evidently it was not excessive.

In 1939 early nodular opacities were discovered in a routine survey chest roentgenogram. No change in this finding was observed in subsequent films made in 1943, 1944, and 1946. In 1947, however, an area of beginning conglomeration was noted under the first rib on the right side. This appeared to be unaltered in a follow-up x-ray examination six months later. In 1949 the density seemed to be slightly larger and the employee's occupational pulmonary condition was classified as siderosis with indeterminate infection. A later roentgenogram, in December, 1949, suggested some beginning conglomeration in the left first interspace, but no further change was noted in films taken in 1950 and 1951. In August, 1952, however, it was felt that the density in the right upper lobe had again shown some increase in size and the nodular roentgenographic pattern was more pronounced. In another film, three months later, no great change was observed but in the roentgenogram of May, 1953, there seemed to be a distinct increase in the shadows involving the upper lobe of the right lung.

During the foregoing period the employee had a series of complete physical examinations, none of which disclosed any significant abnormal finding. Another check-up, in August, 1952, showed him to be apparently in good health and without complaint. He had gained three pounds, to bring his weight to 160 pounds. The blood pressure was 125 systolic

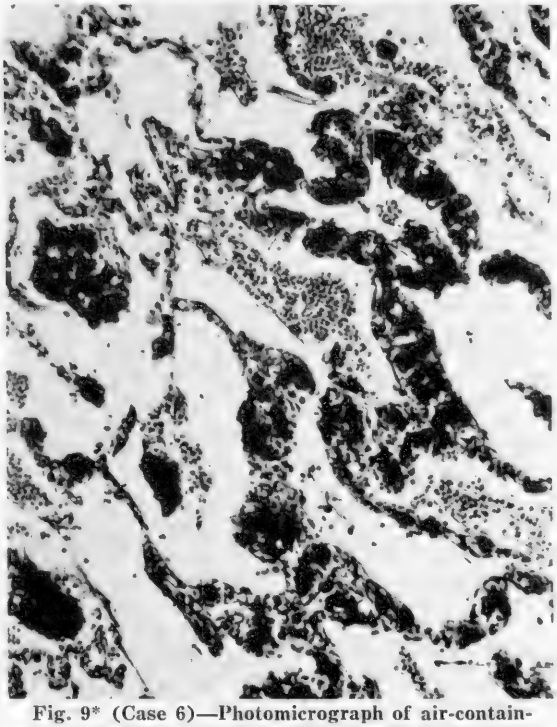


Fig. 9* (Case 6)—Photomicrograph of air-containing parenchyma about the fibrotic mass in the right upper lobe. The alveolar spaces are moderately distorted. Some spaces contain scattered elements of blood and large masses of inhaled pigment. The latter is also present in segments of the alveolar septa. The pigment exhibited a positive microchemical reaction for iron. With respect to the pigment, it is important to note the absence of significant inflammatory reaction. Magnification × 90.

*Pathology sections (Figs. 7, 8, 9, and 10) were supplied through courtesy of A. S. Vorwald, M.D., Wayne State University, Detroit.

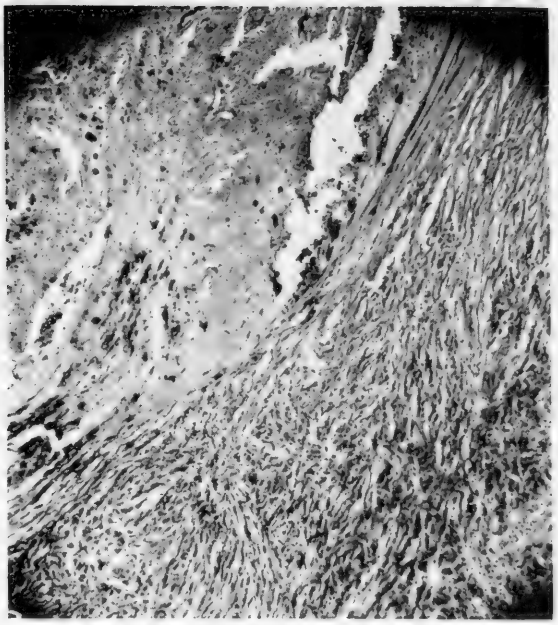


Fig. 10* (Case 6)—Photomicrograph which illustrates a segment of fibrocaseous lesion present in the resected right upper lobe. Small black masses of iron pigment are scattered throughout. The lesion is consistent with a focal tuberculous infection. The absence of inflammatory reaction to free crystalline silica may be noted. Magnification × 90.

and 80 diastolic and the pulse rate at rest 72 per minute, after exercise 110, and two minutes later 74. The quality was good and the rhythm regular. The heart was normal and the lungs were clear, although breath sounds were distant in the left apical area.

Because of the changes noted in the latest roentgenograms, the employee was requested to have further investigation of his lungs. Accordingly, intensive clinical and laboratory studies were carried out during the next two years (1953 and 1954). The examinations included gastric lavage cultures by both slide and solid methods and inoculations of guinea pigs and pigeons with the atypical acid-fast bacilli or saprophytes produced by the cultures. Results of these tests were negative, as were tissue cultures from the animals.

At this time planographic roentgenological study confirmed the presence of a cavity in the conglomerate lesion in the apex of the right lung, and, in spite of the complete absence of abnormal physical findings, tuberculous infection was thought to be the most likely diagnosis. Subsequent procedures continued to demonstrate the presence of the same acid-fast bacilli or saprophytic organisms, although the employee remained symptom-free. Successive afternoon temperature readings over a five-day period were not elevated, and findings on an electrocardiogram were within normal limits. Additional roentgenograms suggested some increase in the nodular densities throughout both lung fields, and the possibility of progression was entertained. Consideration was given to the fact that the continuous presence of acid-fast bacilli, even though of low or unproved virulence, might well be partially responsible for such a development.

The employee was treated at different intervals with various antibiotics and chemotherapeutic agents, which included procaine penicillin, 300,000 units per cubic centimeter administered daily in doses of 1 cc; streptomycin, 1 gm three times a week, and isoniazid, 300 mg daily. An aminosalicylic acid-isoniazid regimen resulted in gastric examination negative for pathogens for a time, but later the cultures again became positive for chromogenic acid-fast bacilli. To date four distinct types of chromogenic acid-fast bacilli have been isolated from the patient.

In spite of the fact that he developed a pulmonary infection of uncertain origin which resulted in formation of a cavity, the employee was allowed to remain under medical observation at his usual job of crane operator in the cleaning room until October, 1957. The illness was tentatively diagnosed as influenza and was characterized by generalized malaise, myalgia, low-grade fever, and cough. When the cough later became productive of a thick mucopurulent sputum streaked with blood. the patient was readmitted to the hospital. He responded favorably to treatment with streptomycin. At this time he was in an isolated section of the tuberculosis ward and the chest roentgenogram showed the presence of a large cavity in the right upper lobe which contained a fluid level. Sputum cultures still revealed chromogenic acid-fast bacilli.

The man's general physical condition continued to be good, but because of the persistence of the dense roentgenographic shadow in the right lung and because of suspicious changes noted on bronchoscopy, a diagnosis of malignancy could not be excluded. Accordingly on Dec. 10, 1957 the upper lobe and a segment of the middle lobe of the right lung were removed surgically. A cavity 3 by 2 by 2 cm was noted in the surgical specimen, and smears of the intracavitary caseous material were positive for acid-fast bacilli. Microscopic sections of the tissue revealed a granuloma of the middle and upper lobes of the right lung and siderosis of the middle and upper lobes of the right lung. The same pathology report states that "the remainder of the lung was found to be normal." Massive deposits of iron were present in macroparticles within the macrophages.

Shortly thereafter a generous section of the lung specimen removed at the operation was submitted to Dr. Arthur Vorwald for further pathological study. Dr. Vorwald reported that the specimen consisted of a "mass of chronic inflammatory pulmonary tissue which exhibited a number of fibrotic and fibro-necrotic focal areas, a small irregular cavitary lesion with bronchiolar communication, all lesions embedded in a dense mass of mature connective tissue with diffuse particulate pigment identified as iron. Lesions characteristic of the tissue response provoked by free crystalline silica were not found either by petrographic, spectrographic, x-ray diffraction or by chemical analyses of the tissue." The report further indicated that

there was a pronounced diffuse and focal deposition of particulate pigment which gave a positive microchemical reaction for iron, which was not always specifically related to areas with the most pronounced inflammatory reaction. In fact, masses of pigment were frequently found in segments of nonfibrotic portions of the pulmonary parenchyma. It was Dr. Vorwald's opinion that the presence of the iron pigment in the lesion was incidental and exerted no unfavorable influence on the natural course of the infection. He also believed that there was no histopathologic evidence that the conglomerate lesion was complicated by a silicotic process and that these findings together with those derived by chemical analyses would exclude free crystalline silica in the etiology of the lesion. It was his impression, however, that the infectious component of the lesion might have been tuberculous but that it had undergone the conventional course of healing under clinical care, including chemotherapy, and that it exhibited no evidence of having been caused and/or aggravated by the employee's occupational exposure to dust.

This case obviously does not conform to the well-recognized concept of silicotuberculosis in terms of either clinical signs and symptoms or disability. Only atypical forms of acid-fast bacilli have been recovered from the lesion, and progression of the disease has remained localized. Exposure to free crystalline silica has been minimal, whereas iron oxide has been present in sufficient atmospheric concentrations in the employee's working environment to produce siderosis. Industrial hygiene surveys from 1949 to 1956 in the crane cab in the cleaning room show gross dust counts ranging from 400,000 particles per cubic foot of air to 4,300,000 particles, with an average of 2,300,000. Iron oxide concentrations over the same period ranged from 4 to 51 mg per cubic meter of air, with an average of 23 mg. These are in contrast to values reported in the previous paper of less than 1 mg to 189 mg of iron per cubic meter of air, with an average of 35 mg. The employee's latest chest roentgenograms, in Dec., 1957, show no appreciable increase in the size of the nodular shadows throughout the remaining lung fields such as ordinarily might be expected in the event that tuberculous infection becomes superimposed on a silicotic process. On the other hand, the present findings are compatible with the deposition of iron oxide pigment in lung tissue. The latest reports on this man's progress indicate that he is making an excellent recovery and in all probability will be able to return to suitable work in the not too distant future. (See further reference to this case in the section devoted to "Discussion" in this paper.)

CASE 7—This grinder, as indicated in the earlier report, had worked continually at the same job without complaint for 25 years. Well-developed nodulation became evident in his chest roentgenogram of 1934.

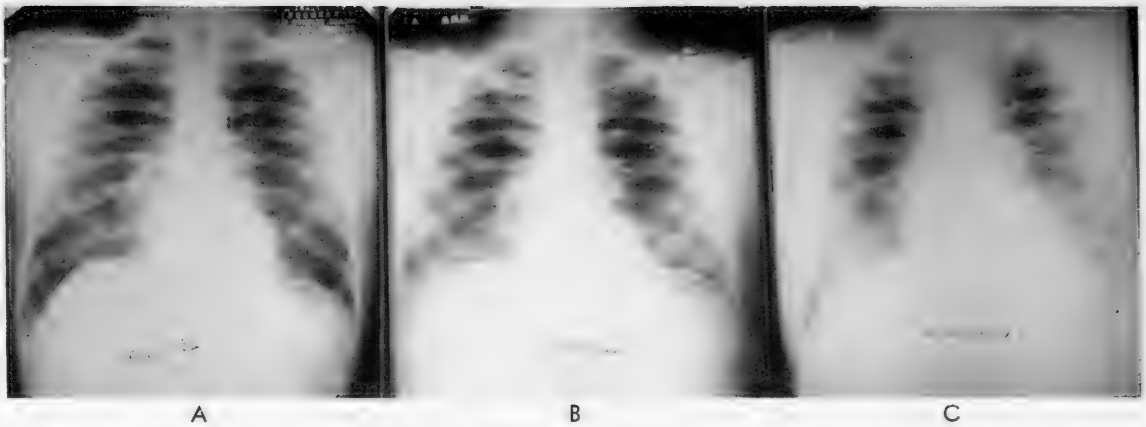
Since 1949 the employee has had chest roentgenograms in 1950, 1953, 1954, 1955, 1956, and 1957. None of these has shown any change other than what might be considered compatible with advancing years and some degree of cardiovascular disease. He is now 61 years of age and has been at his regular job of stiff shaft grinding in the same area of the plant where he has always worked. He now has a total of 33 years in this type of employment. The dust to which he was exposed has not varied, particularly in composition or atmospheric concentration, although the working environment of the plant generally has been improved.

A routine periodic health examination in September, 1951, elicited no complaint and revealed no time lost from work since the previous examination, in October, 1948. The systolic blood pressure was 154 and the diastolic 80. The pulse rate at rest was 72, after exercise 100, and two minutes later 72, and the quality and rhythm were good. The man's height was 5 feet 6 inches, and his weight 169 pounds. Examination of the heart and lungs disclosed no definite pathologic changes, and there was no findings of disability beyond a minor degree of impaired vision.

A repeat chest roentgenogram in May, 1953, was unchanged except for some elevation of the left leaf of the diaphragm. Another physical examination at this time revealed an increase in weight of 15 pounds. The blood pressure was 130 systolic and 76 diastolic. At this examination a faint aortic systolic murmur was detected, but there were no abnormal pulmonary findings. The employee had no other complaint or symptom. He had no difficulty in handling his job of grinding.

In January, 1956, an additional physical examination showed a further increase in weight to 190 pounds and a slight rise in the systolic blood pressure to 140. The diastolic blood pressure was 74. The aortic systolic murmur was again noted, but there was no further change in this or the pulmonary findings. The heart was compensating adequately, and the employee felt well. No change in the nodular roentgenographic pattern has been observed, although the man has been subjected to atmospheric concentrations of iron oxide fume and dust since 1949 ranging from less than 1 mg of iron oxide per cubic meter of air to 21 mg, with an average of 6 mg. While these amounts are considerably lower than those published in 1950 (range 19 to 90 mg of iron oxide per cubic meter of air, average 39 mg), it is possible that some of the higher concentrations might be capable of producing radiographic changes if encountered over a long period of time. The fact that no such alteration has occurred attests to the inert character of the dust.

CASE 8—This employee has been a stiff shaft grinder in the same area of the cleaning room since 1935 and is now 43 years of age. Nodular shadows appeared in the chest x-ray film after six years' exposure to dust. Since his case was reported in 1949 he has had chest roentgenograms in 1950, 1951, 1953, 1954, 1955, 1956, and 1957, none of which have shown any marked change, in spite of the fact that his job has remained the same. Periodic health examinations in 1948, 1951, 1953, and 1956 showed a healthy man with no symptom or sign of pulmonary disease whatsoever.



A B C

Fig. 11 (Case 7)—Serial roentgenograms in 1934 (A) and 1948 (B) show no change in nodular shadows due to siderosis. The latest x-ray film (C), made in 1957, shows cardiovascular alterations resulting from a heart condition which developed in 1953. Allowing for these and the fact that the employee has gained considerable weight, it is felt that the nodulation has not progressed.

The employee has always maintained that his health is "good," and he has lost no time from work except four days because of a "cold" in 1953. His latest examination revealed a blood pressure of 132 systolic and 66 diastolic. The pulse rate at rest was 80 per minute, after exercise 120, and 2 minutes later 80. The quality and rhythm were good. His height was 5 feet 11 inches and his weight 189 pounds.

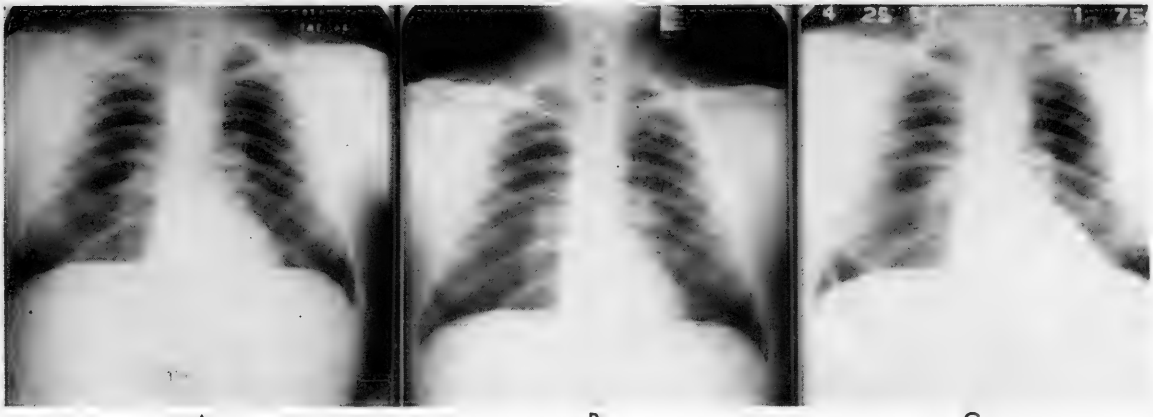
Continual occupation for 23 years in a plant where there has been considerable exposure to a dust composed mainly of iron oxide and a small percentage of free crystalline silica apparently has not affected this worker in any degree other than to produce characteristic nodular shadows in the chest roentgenogram. If the concentration of free silica known to be present is significant, one would certainly expect more definite evidence of progression of these shadows than appears to be the case. Also it would be logical to expect some signs or symptoms of disability from this source. Since such findings have not been encountered, the inertness of this cleaning room dust would appear to be confirmed. Industrial hygiene surveys from 1951 to 1955 showed iron oxide exposures ranging from 3 mg per cubic meter of air to 63 mg, with an average of 19 mg. These values reflect improved working environments from the previous era, when exposures ranged from 19 to 90 mg of iron per cubic meter of air, with an average of 39 mg. While the development of a roentgenographic pattern of siderosis would be unlikely under these improved conditions, the possibility of such an occurrence should be kept in mind.

CASE 9—Definite roentgenological nodular shadows were observed in this employee's first chest film, in 1933. No further change was noted in subsequent radiographs until the time his case was reported in 1949.

After the year 1949 he had chest x-rays in 1950, 1951, 1953, 1954, 1955, 1956, and 1957. There have been no alterations in the nodular pattern or other aspects of the lungs in any of these later films, in spite of the fact that the employee was employed uninterruptedly at his regular job of machine grinder until December, 1955. At this time he

A B C

Fig. 12 (Case 8)—X-ray film (A) of 1935 reveals a normal chest, while film (B) of 1948 disclosed the well-developed, discrete nodular pattern of siderosis. No further change is observed in roentgenogram (C) of 1957 other than possibly some accentuation of the pulmonary markings compatible with age.



A B C

Fig. 13 (Case 9)—Nodulation due to siderosis is evident in the 1934 (A) and 1946 (B) films. The roentgenogram (C) of 1957 is underexposed, but when allowance is made for the underexposure and cardiovascular changes resulting from age, no progression of the pulmonary nodular pattern is evident.

placed a bid for the job of janitor in the pattern shop, and because he had ample seniority he had no difficulty in obtaining the transfer. He took the step because he had reached 60 years of age and wanted easier work. He was willing to accept the lower rate of pay involved in the new position. Previous physical examinations had disclosed a cardiac irregularity, although the employee had experienced no symptom attributable to heart disease or difficulty in performing his duties as a grinder. No respiratory complaint was involved in the request for a transfer.

Additional physical examinations were performed in January, 1952, 1954, and 1956. In the 1952 and 1954 examinations the only abnormal findings were the aforementioned irregular cardiac rhythm and impaired vision. The latter was satisfactorily corrected. In the examination of June, 1956, the arrhythmia had disappeared and the heart was considered to be normal. At no time was there any unusual pulmonary sign. The blood pressure at the most recent check-up was 126 systolic and 74 diastolic. The pulse rate at rest was 80 per minute, after exercise 108, and 2 minutes later 80. Quality and rhythm were normal. The employee made no complaint and stated that he felt well. He lost only two days from work during the past year because of a cold.

This man has been a machine grinder for 34 years and has always worked in the same location of the plant. He has had chest roentgenograms since the year 1933, when the nodular pattern in his chest x-rays was first discovered. No change has occurred in the roentgenograms during this period of 23 years other than those alterations which might be associated with advancing years, although the employee has worked in an area where he has been exposed to a dust composed mainly of iron oxide and a low proportion of free crystalline silica. Atmospheric samples of dust from this working place over the last nine years revealed iron oxide concentrations ranging from 5 mg per cubic meter of air to 29 mg, with an average of 15 mg. Although these amounts are somewhat lower than in previous years, when they ranged from 18 to 84 mg of iron per cubic meter of air with an average of 29 mg, it is conceivable that the employee might still have been exposed to excessive concentrations of iron oxide from time to time during the more recent period of observation.*

Discussion

Recently McLaughlin and Harding,[3] of England, have taken exception to some of the conclusions expressed in our original presentation on the grounds that no human pathology studies have been presented and that negative results in laboratory animals cannot be safely taken as applying to man. Human pathology studies have not been cited because the opportunity of obtaining necropsy material has not presented itself, largely for the reason that these employees have not died or become disabled as a result of the occupational changes observed in their chest roentgenograms. As stated in the preceding paragraphs, those who *have* died did so from ailments unrelated to their employment, such as hypertensive heart disease, cerebral hemorrhage, accident and/or other cardiac conditions.

Granted that the autopsy is the best means of establishing the cause of death and that it affords a more precise method of evaluating the effect of dust on the lungs, it is not infallible; nor do the findings necessarily reflect specific

*Since the foregoing reports were written, additional chest roentgenograms were obtained in 1958 for all but two of these employees. One man (Case 1), now retired, failed to report at the time of the survey, while another (Case 3) died in 1952. A third man (Case 6) underwent surgery as described, and his latest films show no change other than that resulting from the excision of the upper lobe of the right lung. The chest roentgenograms of the remaining six workers show no change from previous films.

environmental conditions or true exposure to harmful dust in which the various components and particle sizes ought to be known. Without such basic information, in our opinion, there is some risk of error in attributing post mortem findings to specific occupational pursuits. To maintain that results in laboratory animals cannot be safely taken as applying to man is to deny the usefulness of these long-established procedures. The vast amount of knowledge concerning pulmonary disease obtained through such methods demonstrates their validity, especially in the case of free crystalline silica, which in animals provokes a pulmonary disease comparable to that seen in exposed humans.

McLaughlin and Harding have implied that we consider *all* foundry cleaning room workers whose pulmonary roentgenograms show nodular patterns to be cases of "pure" siderosis, despite the fact that we tried to avoid giving such an impression. In fact, it was stated in our original paper that "unlike the cases of siderosis described by Sander and Enzer[4] the men in our group were known to have some degree of exposure to free silica as well as iron oxide." Hygienic engineering studies of the actual working environments, however, failed to disclose atmospheric concentrations of free crystalline silica of respirable size sufficient to produce silicosis when judged by present day accepted safe limits. These same investigations on the other hand *did* demonstrate amounts of iron oxide at the breathing level of the workers sufficient to cause siderosis. The failure of this dust to produce silicosis in susceptible animals, together with the fact that nodular shadows comparable to those seen in the lungs of the cleaning room workmen developed in the pulmonary tissue of the rabbits, rats, and guinea pigs, furnished additional convincing evidence that in these particular employees our conclusions were justifiable. Furthermore, it is important to reiterate here that none of the men in the entire study displayed any of the classical signs or symptoms of silicosis nor, with two possible exceptions, did they follow the pattern of increased susceptibility to tuberculosis which has long been associated with this occupational ailment. One of the exceptional cases is an employee who showed extensive nodulation in his chest roentgenogram and developed active tuberculosis; but this healed completely after hospitalization and treatment over a period of only six months. The other is reported as Case 6 in this paper. This course of events is not in accord with the usual progress of a tuberculous process under the adverse influence of free crystalline silica.

It is recognized that cases of pulmonary fibrosis have been reported from exposure to dust containing as little as 4% free crystalline silica, but we believe that they are rare and in such instances the diagnosis is frequently open to question. There is good general agreement among those experienced in occupational disease of the lungs that it is very difficult to produce recognizable silicosis in animals or humans by exposing them to dust containing free silica in such small amounts. In our experience it is extremely unusual to observe demonstrable evidence of silicosis in the chest roentgenograms of employees exposed to air-borne dust concentrations of this magnitude over many years.

Like most observers, we have found a number of employees in our plants who have developed industrial disease of the lungs from exposure to a combination of dusts containing iron and free crystalline silica, but these cases are less common and can usually be accounted for when the hazards associated with their specific occupations are investigated. The term "mixed dust fibrosis," which McLaughlin suggests for this condition, might be criticized on the grounds that it is not specific. It also implies that *any* mixed dust is capable of causing a fibrogenic response in lung tissue. It is also our feeling that his statement "every foundry operation is capable of producing dust fibrosis in the workers' lungs" is misleading, as there are many jobs in modern foundries that offer no hazard at all from dust and those that do are rapidly being controlled.

In evaluating any occupational disease the need for accurate investigation and proper diagnosis is obvious, but at the same time the practical implications of the findings must be considered as well as their application in the workaday world. To emphasize the exceptional or unusual cases to the exclusion of the greater number that exhibit signs or symptoms in common may tend to defeat the basic precepts of industrial medicine, which are to assist workmen in performing their daily tasks and skills without damage to their health. Other important considerations in this category involve interference with training and technical proficiency acquired through long years of service, the impact on the economic status of the employee, and fairness to those who provide the opportunity of making a living.

Andrews and Klassen[5] in July, 1957, reporting on a series of 118 pulmonary biopsies over the preceding eight years, described the case of a grinder of castings for 35 years for whom a diagnosis of silicosis had been made but whose biopsy specimen demonstrated siderosis.

While the limitations of the biopsy are recognized, the evidence in this case is difficult to controvert because consideration of the widespread character of the abnormal pulmonary roentgenological shadows would certainly suggest that *some* classical nodules would be seen in the microscopic sections if free crystalline silica were a contributing agent. These authors state also that "pneumoconiosis was found in less than half of the patients who were suspected of having such a lesion," a result which can be reconciled with general experience in many other dusty occupations.

With further reference to the report on the employee listed as Case 6, Dworski, Wilson, McCreary, Delahant, and Schepers[6] reported an instance of fatal pulmonary disease caused by atypical acid-fast bacilli occurring in a man with silicosis in which the infection progressed in spite of continuous chemotherapy and bed rest. In this instance there had been definite exposure to free crystalline silica, since the worker had been employed as a stone cutter, polisher, and sand blaster over a period of 17 years. The fact that the atypical acid-fast bacilli became pathogenic in the presence of free crystalline silica suggests that the latter is not present in sufficient amounts in our case to be a substantial factor in his present illness.

In February, 1957, Wolinsky, Smith, Mitchell, and Steenken[7] reported three cases in which atypical chromogenic mycobacteria were associated with pulmonary disease. One of these persons had worked in dusty atmospheres where he had been exposed to "silica and carborundum dust." He was employed as a coal miner from 1933 to 1940, a tool grinder from 1941 to 1944, and a machine tool repairman from 1944 to 1954. Each of these men underwent surgery for unilateral cavitary lesions, and in every instance, chromogenic, guinea-pig-avirulent mycobacteria were found repeatedly in the sputum and in cultures from the lung tissue removed at operation. There was no indication of silicosis in the excised lung of the man who had been exposed to silica dust. All three men made excellent recoveries following surgery and have remained well since. The results in these people would tend to support a favorable outlook when surgery is employed as a therapeutic measure.

The absence of progression of nodulation over the past eight years in the roentgenograms of the great majority of the cleaning room workers whose case histories were first reported in 1950, together with additional clinical examination findings and other follow-up measures, confirms the initial impression that the type of dust to which they were exposed is inert and the benign pneumoconiosis they developed is mainly the result of exposure to iron oxide rather than free crystalline silica. The pulmonary occupational disease observed in these men has not followed the pattern of silicosis in any instance in that there has been no conclusive increase in size or distribution of the nodules roentgenologically nor has any physical sign or symptom of disability developed which might be attributed to exposure to uncombined silica particles. This situation has prevailed, although many of the employees have been continuously exposed to fairly high concentrations of dust in the cleaning room over this period. The ailments that *have* occurred, such as hypertensive heart disease, are those that might be expected in any group of people in the general population. Allowing for five deaths from cardiovascular conditions or accident and five terminations of employment, the fact that 85.5% of the group are still living, with 69.5% of these actively employed, substantiates our contention that free crystalline silica is not a cardinal factor in this industrial condition.

Summary

Results of follow-up clinical and roentgenological studies on 69 foundry cleaning room employees originally investigated in 1949 are presented after a period of eight years' further observation.

Allowing for five deaths from causes unrelated to occupation and five terminations of employment, 85.5% of the workmen in this group are living and 69.5% are actively employed, the majority at their regular jobs of grinding castings.

No progression of the nodular shadows previously noted is apparent in serial chest roentgenograms of these workers, despite the fact that at least half of them have continued to work under fairly high atmospheric concentrations of cleaning room dust over a long period of time.

No adequate reason has been demonstrated to alter the conclusion reached in our original study that the nodular patterns observed in these employees' chest roentgenograms represent mainly siderosis rather than silicosis.

The present study again demonstrates the necessity for adequate physical examinations, including detailed occupational histories and knowledge of atmospheric concentrations of harmful dust, before making a diagnosis of specific pneumoconiosis.

Acknowledgment

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References

1. Hamlin, L. E., and Weber, H. J.: Siderosis—A Benign Pneumoconiosis Due to the Inhalation of Iron Dust: Part I. A Clinical, Roentgenological and Industrial Hygiene Study of Foundry Cleaning Room Employees, *Indust. Med. & Surg.* 19:151-169 (April) 1950.

2. Vorwald, A. J.; Pratt, P. C.; Durkan, T. M.; Delahant, A. B., and Bailey, D. A.: Siderosis—A Benign Pneumoconiosis Due to the Inhalation of Iron Dust: Part II. An Experimental Study of the Pulmonary Reaction Following Inhalation of Dust Generated in Foundry Cleaning Room Operations, *Indust. Med. & Surg.* 19:170-180 (April) 1950.

3. McLaughlin, A. I. G., and Harding, H. E.: Pneumoconiosis and Other Causes of Death in Iron and Steel Foundry Workers, *A.M.A. Arch. Indust. Health* 14: 350-378 (Oct.) 1956.

4. Enzer, N., and Sander, O. A.: Chronic Lung Changes in Electric Arc Welders, *J. Indust. Hyg. & Toxicol.* 20:333-350 (May) 1938.

5. Andrews, M. C., and Klassen, K. P.: Eight Years' Experience with Pulmonary Biopsy, *J.A.M.A.* 164: 1061-1069 (July 6), 1957.

6. Dworski, M.; Wilson, G. E.; McCreary, H. W.; Delahant, A. B., and Schepers, G. W. H.: Fatal Pulmonary Disease Caused by an Atypical Acid-Fast Bacillus: A Bacteriologic and Clinical Study, *Indust. Med. & Surg.* 26:536-540 (Dec.) 1957.

7. Wolinsky, E.; Smith, M. M.; Mitchell, R. S., and Steenken, W.: Atypical Chromogenic Mycobacteria Associated with Pulmonary Disease, *Am. Rev. Tuberc.* 75:150-196 (Feb.) 1957.

Industrial Physicians Guests of Army Ordnance Missile Command

Officials of the Association of Ordnance Industry Physicians and members of seven Alabama county medical societies were guests of the Army Ordnance Missile Command recently for orientation tours and conferences. Shown at a joint dinner meeting at Redstone Arsenal are (left to right, front row): Col. C. C. Canada, White Sands Missile Range, N.M.; Col. Harry C. McClain, Redstone Arsenal Post Surgeon; Burton S. Shook, M.D., Chief, Medical Staff Occupational Health Service, Redstone Arsenal; Laurence P. Devlin, M.D., Frankford Arsenal, Philadelphia; Frank L. Fisher, M.D., Kingsburg Ordnance Plant, LaPorte, Indiana. Back row: Col. Owen T. McCloskey, Deputy Commander, Redstone Arsenal; Arthur L. Knight, M.D., Bausch and Lomb, Rochester, New York; Col. Arthur P. Long, Surgeon General's Office, Department of the Army; and Allan J. Fleming, M.D., Medical Director of E. I. du Pont de Nemours and Company, Wilmington, who was principal speaker at the dinner. In the photograph, Dr. Fisher holds certificate of honorary membership in Association which was later presented to Maj. Gen. J. B. Medaris, Commanding General, Army Ordnance Missile Command.

Professional Liability

—RESULTS OF A NATIONAL SURVEY

Edwin J. Holman, Chicago

UNTIL a few months ago, the medical profession was handicapped in its consideration of malpractice problems and in the formulation of a prevention program by a lack of reliable data as to the incidence and cause of claims and suits. I am happy to say that we now have a better basis on which to proceed as a result of a survey which the American Medical Association Law Department has been making for the past two years. The Law Department conducted a random sampling of 5% of the members of the American Medical Association, approximately 7,500 physicians. It asked them many questions concerning the subject of malpractice in general and their experiences in particular. Then it sent a follow-up questionnaire to those persons who indicated that a claim or suit had been brought against them in the past. The Department also completed an analysis and evaluation of all suits in the United States which reached the Court of Appeals during the last 20 years, approximately 1,000 cases.

A survey was made of all of the state and larger county medical societies to solicit their opinion and to determine what they were doing or had done in the past in connection with professional liability. In addition, a series of 18 specialized articles in this field were published in The Journal of the American Medical Association and are to be republished in booklet form later.

Some may wonder why statistics were not obtained from the primary source, the files of the insurance companies, rather than from individual physicians. The answer is simple and yet surprising. Most of the insurance companies in this field, of which there are approximately 45 in the United States, do not segregate their statistical data on their malpractice experience but lump it in with their other casualty insurance coverage. Other companies are reluctant to release the information, even though no one of us is interested in the identity of the physicians involved.

With the exception of those companies that are operating group programs with the cooperation of county or state medical societies, the Law Department has had very little active cooperation in this regard. Only two other companies have supplied the information which was requested during the past three years. On two occasions, Mr. Stetler, Director of the Department, met with the National Bureau companies in New York and urged them to supply us with the data if they have it or at least to initiate proper record-keeping procedures in this field in the future. At present, it is not possible to report more optimistically with respect to the results of these conferences.

Admitting in advance, therefore, certain limitations in connection with the figures let me proceed with what I believe are the *only* and therefore the *best* national statistics in the field.

Fourteen per cent of all A.M.A. physician members in the United States have had a medical professional liability claim or suit brought against them. The highest percentage is in California, with 1 out of 4, and the lowest is in South Carolina, with about 1 out of 33. Approximately 18,500 living physicians in the United States have had a claim or suit at some time.

These figures at first blush sound rather frightening; however, let us analyze them. They represent all of the claims brought against all living physicians, whose length of practice ranges from 1 year to as long as 40 or 50 years. Furthermore, 40% of these claims and suits have been dropped or decided in favor of the physician.

Mr. Holman is a member of the Law Department, American Medical Association and executive secretary of the Judicial Council.

The next question which logically presents itself is, how many physicians are malpractice prone? From our survey we have learned that of the physicians who have had claims, 87% have had but one; 10% two; and 3% three or more. Thus 13% have had more than one claim.

We also asked physicians if, in their opinion, medical professional liability claims had increased over the past five years. Strangely enough, only 29% felt that they had; 40% said there had been no change. Physicians in some of the states had a decidedly different opinion in answer to this question. Sixty per cent of the physicians in California felt that claims had increased in their community.

What type of practice does the physician engage in who is involved in these claims or suits? The Law Department's study disclosed that the full-time specialist is most frequently the defendant. This is not surprising if you remember that the average claimant probably assumes that the medical specialist has a higher income and probably carries more professional liability insurance than the nonspecialist. The claimant may see the full-time specialist only a few times and for this reason may not have the same personal feeling toward him as he does toward his family physician. Then, too, the full-time specialist is probably faced with more complicated and complex medical problems than the average nonspecialist.

Our inquiry also revealed that 29% of the physicians who have experienced a claim or suit were board-certified at the time the alleged negligent act was performed. You may be interested to know that only 22% of the physician population in 1956 was board-certified. Probably the reason that a slightly higher percentage of physicians having claims or suits are board-certified is again due to the complexity of the medical problems which they handle.

As I stated earlier, some 14%, or 1 out of every 7, of the members of the American Medical Association have had a claim or suit brought against them. Is it the recent medical school graduate who is faced with these claims or suits? The answer to this question is *no*. We have found that there are as many physicians who have been practicing more than 13.4 years involved in these claims and suits as there are physicians who have been practicing less than this period of time. In other words, the median or average is 13.4 years.

Thirty-one per cent of the alleged negligent acts occurred in the field of surgery, 20% in the field of medicine, 20% in orthopedics, 12% in obstetrics and gynecology, and 17% in other fields.

We have found in our survey that 93% of the physicians in the country had professional liability insurance coverage at the time the claim or suit was brought against them.

In my opinion, the information which we have collected in our survey explodes some of the myths that have existed for many years with respect to medical professional liability. We have heard for some time how difficult it is to obtain medical professional liability insurance. However, more than 9 out of 10 physicians indicated that they have had no difficulty in obtaining insurance. Only 1% indicated any serious difficulty in obtaining insurance.

Medical society executive secretaries, in response to a questionnaire which was sent to them, advised that at least 45 insurance companies write this type of insurance in this country. Not all of them write in every state. Twenty-six of these companies are active in only one or two states, and in addition, we have found that 13 state medical societies have either a group insurance program or have endorsed a particular type of policy.

What about the cost of this insurance? Do the doctors consider the cost to be excessive? Prior to our study I would have said that most physicians believe that it is excessive. As a matter of fact, our study was prompted in part by the fact that physicians complained about the excessive cost of this insurance. However, some 56% of the physicians indicated that in their opinion the cost of the insurance which they carry is reasonable.

One of the most important aspects of this problem is, of course, a consideration of the causes of malpractice claims and suits. In analyzing the reasons given by physicians, we have divided them into primary and secondary classifications. Our study showed that in 24% of the cases reviewed the reason for the claim was a poor operative result; in 20% of the cases, poor medical results; in 10%, errors in diagnosis; and in 9% foreign bodies were left in the patient. The other remaining categories specified occurred in 8% or less of the cases. As I stated, in the majority of these cases there was also a secondary factor which was extremely important in causing the claim or suit to be filed.

I should like to point out that 27% of the secondary causes listed are under the direct control of the medical profession. This 27% includes careless comment about another physician and situations in which the patient had another disease or disability which was not properly diagnosed or which progressed badly. Some 22% of the secondary causes consist of pressures or influences exerted on the claimant by outsiders, such as an attorney or a relative.

The patient himself is a producing factor in 25% of the secondary causes. Such factors include bringing a claim for financial profit, the avoidance of paying a medical bill, or because of a mental disability or the fact that the patient was an alcoholic or narcotic addict.

In 67% of the cases the negligent act occurred in the hospital, in 24% in the doctor's office, in 6% in the patient's home, and in 3% at work or elsewhere.

As a result of the high incidence rates in hospitals, the American Medical Association and the American Hospital Association have appointed a joint committee to analyze the problem more thoroughly and to formulate an effective in-hospital prevention program. In addition, a film sponsored jointly by the two associations is being prepared as a preventive aid in connection with in-hospital malpractice problems.

Now, then, what about the outcome of these claims and suits? We have found that 7% of the claims are still pending; 17% have been dropped; 33% have been settled or compromised, and 43% became suits. In tracing the status of the claims that became suits, we found that 18% are still pending, 12% were dropped, 20% compromised, 9% decided in favor of the claimant, and 41%, against the claimant.

Analyzed in retrospect, nearly all professional liability claims are theoretically preventable. For many years we have been stymied in our efforts to combat this serious problem. However, armed with the information which we now have and with what we expect to get during the next year from a survey of available insurance company records and from an opinion survey of the legal profession and the judiciary, the medical profession should be able to move forward with greater confidence and with better success in its battle with this problem.

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The Etiology of Aplastic Anemia

INDUSTRIAL CHEMICALS versus THERAPEUTIC CHEMICALS

Allan J. Fleming, M.D., Wilmington, Delaware

IT MAY BE fairly stated that aplastic anemia is not commonly associated with exposure to industrial chemicals, particularly under conditions prevalent in modern chemical plants. Early in the century, aplastic anemia was frequently noted following overexposure to benzene, particularly in Germany, England, and Italy, following a report by Santesson,[1] in 1897, in which he recorded the first cases of chronic benzene poisoning. Since that time, two other compounds, dinitrophenol and trinitrotoluene have been implicated, and, more recently, a mixture of D.D.T. (dichlorodiphenyltrichloroethane), chlordane (octachloro—4,7=methanohydroindane), and Lindane (benzene hexachloride) is reported to have caused aplastic anemia in a 16-year-old boy.[2] A single report of aplastic anemia due to carbon tetrachloride[3] has been criticized[4] for lack of proof of coincident exposure to other solvents such as benzene.

Wintrobe[5] lists 25 drugs associated with the occurrence of aplastic anemia, and E. E. Osgood[6] lists 25 agents known to produce hypoplastic syndromes of drug idiosyncrasy type. Of these agents, only the nitrophenols are of industrial significance. Osgood prefers the term hypoplasia rather than aplasia since complete disappearance of cells from the blood-forming organs practically never occurs and since erythrocytic, granulocytic, and thrombocytic hypoplasia may occur separately or together. He points out that before attributing aplasia or aplastic anemia to drugs or chemicals it is necessary to keep in mind other causes of hypoplasia, such as bacterial, viral, or parasitic infections, nutritional and endocrine deficiencies, endogenous toxins, congestive splenomegalies, thymomas, and other rarer and more obscure causes of hypoplasia.

In the chemical industry today, every effort is made to eliminate or reduce exposure to toxic chemicals to a safe level. In the past, however, the delay in correcting overexposure to known toxic agents at times has been appreciable. Although the first recorded cases of industrial poisoning from benzene were reported in 1897, the number of cases reported in Germany 24 years later was 56 with 4 deaths. However, a concerted effort was made to improve industrial hygiene in operations utilizing benzene, and by 1928 only four cases of benzene intoxication were noted in Germany with no deaths.

A comparison of the deaths and illness from trinitrotoluene during World War I and World War II indicates the effectiveness of the control measures introduced during the second World War. McConnell and Flinn[7] summarized the findings in 22 fatalities occurring in the United States during World War II between June, 1941, and September, 1945. This is in sharp contrast to the 475 deaths that occurred in the States during the first seven and one-half months of World War I.

The possibility of exposure to T.N.T. is much less in a manufacturing plant than in a shell-loading plant, since in the latter the T.N.T. must be melted and there is more chance of inhaling fumes and dust, or absorbing the compound through the skin. The du Pont Company operated four T.N.T.-manufacturing plants employing some 4,000 persons during World War II, producing some one and a quarter billion pounds of the explosive. By maintaining rigid standards with respect to permissible levels of T.N.T. in the air, enforced showers after work, and the use of freshly laundered clothing, gloves, and caps each day, we were able to cut down exposure so that no cases of toxic hepatitis or anemia developed in the four-year period these plants were in operation. I believe that this experience was duplicated at the plants operated by the Hercules and Atlas Powder companies.

Dr. Fleming is Medical Director, E. I. du Pont de Nemours & Company.

There may be several reasons why therapeutic chemicals are more often associated etiologically with aplastic anemia than industrial chemicals.

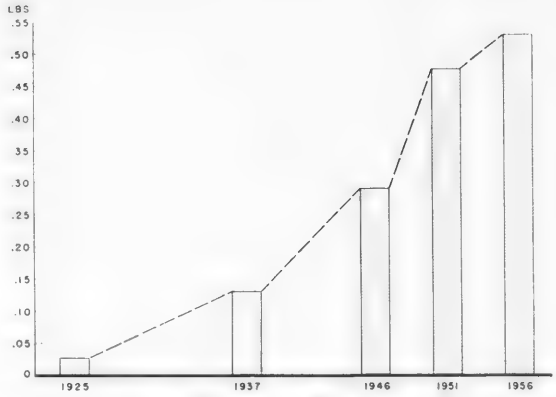
When a drug is given, it is invariably given in what we term an effective dose, which is some optimal level between the minimal dose (smallest amount having a therapeutic effect) and the maximum dose (the largest amount that can be tolerated without toxic symptoms). In the chemical industry, we seek to avoid having anyone exposed to even a minimal dose, which by our standards, is a dose or exposure producing any measurable effect. To do this, we try to keep the concentration of a gas, vapor, or dust in the atmosphere well below permissible limits and also provide means of avoiding skin contact. In this way, even the most toxic compounds can be manufactured and handled safely.

Table I—Relative Exposure to Industrial and Therapeutic Chemicals

Chemical	Max. Inhaled in 8 Hour Day mg	Drug	Daily Intake mg
Benzol	8-12	Meprobamate	up to 1,200
Chlorobenzene	10-15	Aspirin	2,400-9,000
Carbon disulfide	16-24	Chloramphenicol	1,750-3,500
Trinitrotoluene	3-6	Quinacrine	300-1,200
Carbon tetrachloride	15-30	Apresoline	200-400
Nitroglycerine	5-7	Nitroglycerine	6-50

In Table I, I have indicated relative exposure to a few industrial and therapeutic chemicals as a means of comparing the allowable daily exposure to moderately toxic industrial chemicals and the daily intake of several well-known drugs. It is obvious that the daily intake of therapeutic chemicals is considerably greater than the possible intake of the industrial chemicals. In industry, it is only when an accident occurs or when established safe limits for chemical exposure are ignored that we get into trouble.

During the past two decades manufacturing chemists have made a concerted effort to determine in advance the possible hazards of new chemicals or products with respect to their effect on the skin, or following absorption into the body by any route, so that safety standards can be established. In the case of any chemical that may be added to a food directly, or indirectly from a packaging material, United States Food and Drug Administration approval must be obtained, and to obtain approval, animal tests carried out over a minimum period of two years are usually necessary.



Drug Production Per Capita

Many chemical industries now have full-time inplant medical service. Through preplacement examinations the state of health of the employee is known and must meet certain standards before he is permitted to enter an operation involving chemicals that may be toxic. The employee is examined periodically to be sure abnormal signs or symptoms are not present. The frequency of the examination depends on the job and the possible hazards involved. Thus, a correlation between medical observations of the worker and measurements of the environment in which he works is possible. Individual variations are assessed and compared with variations in the group. Often, factors outside the industrial plant are found to be responsible for individual variation. One of these factors is the large number of chemicals used therapeutically, and the number of these substances is expanding rapidly. A note in the March 20, 958, issue of the *New England Journal of Medicine*[8] indicated that the pharmaceutical industry and allied professions produce about 400 new products each year. In 1957, of the 400 offerings, 51 were new single chemicals and 261 were new compounded products. The remainder were probably new mixtures of established compounds. We would be busy physicians, indeed, if we took the time to become acquainted with the therapeutic effect of all these products, let alone their possible toxic effects.

Table II shows the growth of production of medicinal chemicals in the U.S.A. from 1925 to 1956 along with the population increase, and Chart A illustrates the increase in the production of drugs per capita based on the data in Table II.

It is difficult to say how much of the drugs produced are actually consumed; it is likely,

Table II—Growth of Production of Medicinal Chemicals in the U.S.A.

	Medicinal Chemicals Pounds Manufactured	Population
1925	3,000,000	115,378,000
1937	17,000,000	129,257,000
1946	40,747,000	139,899,000
1951	73,543,000	153,900,000
1955	78,727,000	165,270,000
1956[9]	89,400,000	168,174,000

Figures from References 9 and 10.

however, that the proportion discarded varies very little from year to year. We see, therefore, there has been a 25-fold increase in the production of medicinal chemicals per capita in a 30-year period. In 1956 about half a pound of medicinal chemicals was produced for each man, woman, and child in the U.S.A. Of the 89,000,000 million pounds of medicinal chemicals produced, in 1956, three quarters of the production was benzenoid compounds (derived from coal tar) and only about half of the total produced was dispensed by physicians.

In 1957, seventeen million pounds of aspirin were manufactured, enough to make 23 billion 5-grain tablets. Vitamins came second on the list, to the extent of some seven million pounds. Little or no medical guidance prevails in the use of these drugs. Instead, the public is deluged with information concerning wonder cures for a variety of symptoms. The information enters our homes via newspapers, magazines, radio, and T.V. The blurbs are cleverly written, clearly phrased, and persuasive. Whatever the symptoms may be, they can be relieved by the preparation in question. Either that, or your money back. This puts such therapeutics on the same basis as the purchase of farm machinery or electrical appliances.

Perhaps, the introduction of so many new synthetic drugs represents progress, but at times it is disconcerting to those of us responsible for preventing injury from chemicals used in industry. Our medical textbooks rightly suggest that exposure to industrial chemicals should be considered in the etiology of diseases like aplastic anemia, but at the present time, the odds are about 12 to 1 in favor of therapeutic agents being responsible.

Time limitations make it difficult in industry to obtain a detailed or reliable history of past exposure to drugs or chemicals at the time of a preplacement examination. As a rule, it is usually possible to obtain a history of impressive reactions, particularly skin reactions, to chemicals or drugs. These, the prospective employee may recall unless he assumes it may interfere with his chance of employment. It is feasible, however, to establish that workers to be assigned in a specific area are of normal health, or at least measure up to certain standards, before being employed in a chemical operation. A normal blood picture would be one of these standards. Osgood[6], in discussing drug-induced hypoplastic anemias and related syndromes, points out the usefulness of the reticulocyte count to determine early unfavorable reactions to drugs, since a reduction in reticulocytes, neutrophils, or thrombocytes in the blood will long precede the development of anemia because of the long life span (120 days) of mature erythrocytes. He suggests that, owing to the difficulty in doing reliable thrombocyte counts, a clot-retraction test be performed. This procedure would be feasible in some selected industrial operations as a measure of normal thrombocytic activity. Such tests as bone marrow aspirations are not within the scope of industrial medicine. Any diagnostic test used in industry must not be too time-consuming, painful, or obnoxious to the employee, and, above all, it must measure changes or trends in physiology rather than pathology if it is to serve any useful purpose in the prevention of poisoning or undue reactions from chemicals. In a periodic examination of the blood, for the purpose of controlling exposure to a chemical, the most likely indications of adverse effect of a chemical on the blood would be a reduction in the reticulocytes, a reduction of the absolute number of lymphocytes, or a reduction in thrombocytes as measured by delayed or incomplete clot retraction. Though the reason for these changes in an individual might not be apparent, an employee exhibiting such changes may be removed at least temporarily from exposure until the reason for the deviation from normal is established.

The probability of developing hypoplastic anemia from occupational exposure to chemicals is very much less than from exposure to chemicals used therapeutically. The chief reason for this is inherent in the relative risk. In industry, the level of chemical exposure is normally kept below a level that would produce any effect in any worker. On the other hand, the level of chemical exposure during therapy is deliberately high enough to produce a desired response even though the risk of undesirable side-effects is appreciable.

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References

1. Leschke, E.: Chemical Toxicology: Modern Meth-

ods in the Diagnosis and Treatment of Poisoning. Translated from the German by C. P. Stewart and O. Dorrer, London, J. & A. Churchill, Ltd., 1934.

2. Exposure to Insecticides, Bone Marrow Failure, Gastrointestinal Bleeding and Uncontrollable Infections, Clinico-Pathologic Conference, *A. J. Med.* 19:274-284 (Aug.) 1955.

3. Straus, B.: Aplastic Anemia Following Exposure to Carbon Tetrachloride, *J.A.M.A.* 55:737-739 (June 19) 1954.

4. McCord, Carey P., and Johnstone, Rutherford T.: Letters to the Editor, *J.A.M.A.* 156:194-195 (Sept. 11) 1954.

5. Wintrobe, M. M.: Clinical Hematology, Ed. 4. Philadelphia, Lea & Febiger, 1956, p. 564.

6. Osgood, E. E.: Drug Induced Hypoplastic Anemias and Related Syndromes, *Ann. Int. Med.* 38:1173-1188 (Dec.) 1953.

7. McConnell, W. J. and Flinn, R. M.: Summary of 22 Trinitrotoluene Fatalities in World War II, *J. Indust. Hyg. & Toxicol.* 28:76-88 (May) 1946.

8. New Products of 1957, Editorial, *New England J. Med.* 258:616 (March 20) 1958.

9. Manufacturing Chemists' Association: Chemical Facts and Figures: Useful Information and Statistics Relating to the Chemical and Allied Products Industries, Washington, D.C. Ed. 1, 1950; Ed. 3, 1957.

10. Synthetic Organic Chemicals: United States Production and Sales, 1956, Report 200, United States Tariff Commission, Washington, D. C., Government Printing Office, 1958.

ACADEMY OF MEDICINE OF CINCINNATI ADOPTS CODE

Code of Professional Relationships for the Practice of Industrial Medicine

Preamble

The adoption of this code by the Academy of Medicine of Cincinnati is intended to clearly define the scope, objectives, and functions of occupational health programs in Hamilton County which is in accordance with the general principles of the American Medical Association as published in their booklet, "Scope, Objectives and Functions of Occupational Health Programs."

It meets the needs and boundaries of occupational medicine. It states in a positive fashion the proper place of occupational health programs in the practice of medicine and it clearly charts the pathway of communication between physicians in occupational health programs and physicians in the private practice of medicine. The Academy of Medicine of Cincinnati recognizes these fundamental principles and promulgates this code to establish a better understanding between physicians in the private practice of medicine and industrial medicine.

Definitions

Occupational health programs are programs provided by management to deal constructively with the health requirements of employees and employers in relation to employment. Industrial medicine is that branch of medicine practiced by physicians in meeting medical problems and needs under occupational health programs.

Objectives

(1) To promote improvement of health of employees through preventive medicine techniques, such as health education and periodic health examinations.

(2) To examine prospective employees in such a manner as to assure placement on a job which will not be harmful to the employee. To repeat physical examinations when warranted for job reassignment.

(3) To protect employees against extraordinary health hazards in their work environment through periodic examinations.

(4) To immunize employees with tetanus toxoid and immunizations required and incidental to overseas employment; all other immunizations are to be administered by the employee's personal physician.

(5) To transfer all nonoccupational conditions to the care of the personal physician of the employee's choice.

(6) To provide emergency medical service to prevent loss of life and relief of suffering until the employee is placed under the care of a physician of his choice.

(7) To accept the responsibility and direction of treatment of an employee suffering from an occupational disease or injury and, when indicated, refer the employee to a qualified physician for indicated care.

(8) To co-operate with community health services.

(9) To encourage reciprocal relationships with personal physicians that lead to the best health interest of employees, such as,

(a) Encourage employees to have personal physicians.

(b) Upon consent of employee, provide mutual exchange of medical records.

(c) To encourage the personal physician to observe and evaluate the working environment of the employee.

Major Blood Vessel Surgery for Traumatic Injury

Brooke Roberts, M.D., Philadelphia

TRAUMA to major vessels is not among the commoner forms of trauma; yet every surgeon, and particularly those caring for military personnel, will, at some time, be called upon to deal with injury to the major vessels. In times of war approximately 60% of all wounds involve the extremities, and a significant percentage of these involve the major vessels.

Vascular injuries are usually associated with serious trauma to surrounding structures. As a result, the vascular injury is seldom the only problem confronting the surgeon. It is often, however, the most serious. The majority of these injuries involve the vessels of the extremities, but if a patient having an injury to a major vessel of the trunk survives to reach the operating room the same principles apply.

In treatment of major vascular injuries our objectives must remain the saving of life, the saving of limb, and the saving of function, in that order. Until recently preservation of function was not too seriously considered in these circumstances, but today the preservation of limb alone is not good enough if function too can be saved. The preservation of function, in general, depends upon the restoration of blood flow adequate to meet not only the demands of tissue at rest but also the demands of muscle during exercise. After ligation of a major artery, collateral circulation may or may not be adequate to meet the demands of the tissue at rest, but seldom is it adequate to meet the demands of working muscle. As a result, function is usually severely impaired, even when the limb survives. The striking improvement in the results of treatment of vascular injuries since World War II is shown by comparing the results in that war with those in the Korean War[1, 2, 4, 5] (Table I).

Table I—Incidence of Amputation

	World War II*	Korean War†
Injury to major vessels of the extremities	49.6%	11.1%
Cases in which direct arterial surgery was undertaken	43.7%	11.1%

*Figures from DeBakey and Simeone.[1]
†Figures from Hughes.[2]

The diagnosis of injury to a major vessel constitutes no problem when there is an open wound and hemorrhage is obvious. Relatively occult injury may occur, however, and be easily overlooked, even in open wounds. The use of arteriography in these circumstances[3] is of great help. Serious arterial damage may likewise occur in closed wounds and often be overlooked until muscle injury has resulted from ischemia. This is particularly true of injuries about the elbow, which may lead to Volkmann's contracture and ischemic paralysis, and occasionally is true of injuries about the knee and other areas of the body. Contusion of an artery may cause such intense spasm as to obliterate the lumen, or it may lead to thrombosis. The importance of examining for distal pulses in all cases of fractures cannot be overemphasized, but it should be realized that the presence of a distal pulse does not necessarily rule out arterial injury.

The first consideration in the management of all open injuries of major vessels is the control of active bleeding. Exsanguination can occur rapidly when a major vessel is injured. A well-applied pressure dressing will ordinarily take care of venous bleeding and frequently

From the Harrison Department of Surgical Research, University of Pennsylvania Schools of Medicine. This work was supported in part by the John A. Hartford Foundation.

halt arterial bleeding. Packing may help greatly in this regard. Tourniquets may be required. If a tourniquet is necessary, it must be applied tightly enough to occlude the arterial circulation and not just the venous circulation. Such tourniquets should be left in place until the bleeding vessel can be controlled and blood replacement is available. Time, of course, is of great importance in these circumstances, and a tourniquet generally should not be left on for more than two hours if the tourniquet is really required for hemostasis. The old practice of releasing it at frequent intervals results in nothing but the further loss of blood. The control of individual bleeding points by hemostats or ligatures is obviously far preferable to the use of pressure. Blood replacement should be carried out as promptly as possible. It is beyond the scope of this paper to go into the treatment of shock as such, but it is wise to keep in mind the fact that if a healthy adult while in the recumbent position shows signs of shock from blood loss he has probably lost more than 1,000 cc of blood, and often more than 1,500 cc.

In the definitive treatment of acute vascular injuries prompt care is of the greatest importance, for irreparable damage may well occur if the interruption of blood flow is nearly complete and lasts for more than a few hours. In addition, intravascular thrombosis will progress with time and further reduce the chances of successful repair, just as in the case of peripheral emboli.

Adequate exposure is essential in the operative care of these patients, and general or spinal anesthesia is usually desirable. A cardinal rule in the operative management of vascular injuries is always to gain control of the vessels proximal and distal to the lesion before exposing the area of injury itself. If this is not done, massive hemorrhage may result and be very difficult to control. When the continuity of a major vessel has been interrupted, considerable judgment must be used in deciding how to handle a particular problem. With high-velocity missile injuries, the vessel may be severely damaged on either side of any actual laceration and adequate debridement of the vessel itself as well as other damaged tissue must be carried out if a successful repair is to be made. On the other hand, if the vessel is wounded by a sharp knife, or a similar object, the debridement required will be far more limited. It is usually unwise merely to close a hole in a vessel wall unless one is reasonably certain that the vessel wall on either side of the injury has not been seriously damaged. Thrombosis will frequently result if there is significant injury to the wall. In these circumstances it is better to excise the injured portion of the vessel and do an end-to-end anastomosis if such can be accomplished without undue tension. If tension is great, a graft will be necessary. When injury has occurred to vessels of minor size or importance and they can be ligated with impunity, there is little to be gained by tedious attempts to restore their continuity. It should be realized, however, that if collateral vessels have been injured, the margin of safety may be markedly reduced when ligating even small vessels. When major vessels, particularly arteries, have been injured, a definite effort to reestablish blood flow should be made when feasible. If the artery must be ligated, the concomitant ligation of the corresponding vein adds nothing.

*Table II—Incidence of Late Thrombosis in Successfully Repaired Arteries**

Type of Repair	Total Cases	Per Cent with Thrombosis†
Direct anastomosis	80	18.8
Vein graft	19	47.4
Artery graft	7	71.4
Lateral repair	9	44.4
	115	

*Figures taken from Jahnke.[5]
†None of these thromboses resulted in loss of the limb.

At the present time a vessel graft is usually one of three types: an arterial homograft, which may be prepared in various ways; an autogenous vein graft, usually the saphenous vein; or a synthetic graft. It is interesting to note in this regard that the experience in the Korean War reported by Jahnke[5] (Table II) indicated that end-to-end anastomosis of the patient's own vessel is far more likely to stay open than is a graft. When grafts were used, autogenous vein grafts had a better record than did homologous artery grafts. Synthetic prostheses were not used at that time.

If direct arterial surgery has been carried out for an injury, it is important that the vessel be covered with viable soft tissue, for if it is left exposed there is a high incidence of infection and "blow-out." These wounds need not be closed, and usually should not be, but the vessels must be covered.

Major veins, when lacerated, can be ligated or sutured. In general, it is preferable to suture such vessels if ligation is likely to result in significant venous stasis or edema. A graft is seldom indicated under these conditions, and there is a high incidence of thrombosis when grafting is attempted. In the leg the anterior tibial group of muscles is particularly suscep-

tible to injury following venous or arterial occlusion. The firm fascial covering of this compartment permits relatively little swelling to occur before its limits are reached. As the pressure increases with the inflow of arterial blood, the muscle will become necrotic. The performance of a fasciotomy is very important in this situation, and it should be carried out before necrosis can develop. We have seen these changes follow the restoration of arterial flow without venous obstruction when a sufficiently long period of ischemia had occurred.

Essentially all muscle in the leg may be lost in these circumstances, and yet the skin, bone, vessels, and nerves may survive. The flexor aspect of the forearm is another area prone to this type of change.

The management of local arterial spasm resulting from trauma may be very difficult. Sympathetic nerve block, local exposure and injection of procaine, and packing with warm saline and 2% papaverine solution may all be used without release of spasm. In such cases resection and replacement of that portion of the vessel must be resorted to if flow is to be reestablished.

After direct arterial or venous surgery, it is wise, we believe, to use antibiotics, and we have usually also used anticoagulants when operating on peripheral vessels in an attempt to reduce the tendency toward thrombosis and postoperative phlebitis, a sequela that is frequent in vascular surgery. The use of anticoagulants may be hazardous if the vessel injury is associated with extensive wounds and should not then be considered. To prevent coagulation. heparin is the preferred drug in the immediate postoperative period, since it can be readily administered and easily counteracted, if necessary, by means of protamine. In the late postoperative period, although there is some evidence to suggest that prolonged use of anticoagulants such as bishydroxycoumarin (Dicumarol) may be helpful in maintaining patency of vessels, the use of such drugs carries with it certain risks and annoyances, and we have not used them routinely.

One of the possible sequelae of arterial and venous injuries is the development of an arteriovenous fistula. When an adjacent artery and vein are both injured, an arteriovenous fistula may be easily established, and it is surprising that such fistulae are not formed more frequently. After such an injury, some clot invariably develops locally, and a channel may then develop through the space between the artery and vein. In time, endothelium grows out in the area of communication and a definite sac may be formed. Such a fistula, of course, shunts the majority of blood from the artery into the low-pressure venous system and away from its normal distribution in that portion of the body distal to the fistula. This diversion of blood, in turn, leads to increased cardiac output and may result in severe ischemia in the distal tissue. It is, however, a potent stimulus to the formation of collateral circulation, and it is for this reason that if the lesion is not repaired promptly it is often wise to allow the passage of a few months before surgical intervention is attempted. Experience has also shown[2] that it is unwise to disturb a self-contained hematoma resulting from a carotid artery injury, particularly if an arteriovenous fistula is present. The passage of even a few days lessens the danger of hemoplegia developing at the time of surgical intervention.

Spontaneous closure of an arteriovenous fistula is very rare, and operation is usually required. There are various surgical methods of dealing with this problem. Where possible, the continuity of both the artery and the vein should be preserved, with preference, of course, being given to the artery.

Another pathologic entity that may develop following an arterial injury is a so-called *false* aneurysm, or pulsating hematoma. Such an aneurysm results from the partial destruction of an arterial wall without actual severance of the continuity of the vessel, but with the formation of a hematoma. The arterial blood begins to circulate through the hematoma, as well as the vessel, and gradually a laminated clot develops. This type of aneurysm is most frequently seen following stab wounds or small missile injuries, and the arterial injury may not be apparent unless an arteriogram is made.

These lesions manifest themselves as pulsating masses which tend to enlarge with time. They usually develop a bruit, which is systolic in time—in contrast to the continuous murmur seen with an arteriovenous fistula—and they are usually not associated with the same degree of distal arterial insufficiency. In contrast to arteriovenous fistulae, they are not associated with high venous pressures unless the lesion causes obstruction of the vein by pressure. They, too, seldom resolve spontaneously but require operation. Here, again, arterial continuity should be restored when possible, but some delay in the operative management of this problem is permissible if the lesion is not threatening to undergo prompt external rupture.

When a vascular injury has been cared for surgically, the patient may develop any complications that may follow surgical procedures in general. However, there are three major

types of complication which are of particular concern to the physician caring for this type of patient: infection, secondary hemorrhage, and thrombosis. Infection is very dangerous in wounds in which there has been major vessel surgery, particularly if a graft has been used. Although infection may not necessarily result in loss of the graft, this possibility always exists, either through thrombosis or through rupture of a suture line or rupture of the graft itself. Secondary hemorrhage is a constant threat. Such hemorrhages may be very profuse and can result in exsanguination of the patient in a short time if the blood is lost externally through the draining area. So long as the wound remains infected, such a calamity threatens, and if the arterial injury is in such a position that a tourniquet can be placed proximal to it, we have made it a rule to have a pneumatic tourniquet constantly in position. These tourniquets are inflated by the mere turning of a switch, and the patient, after proper instruction, can thus protect himself if there is a sudden loss of blood. When an infected wound is not in such a position that a tourniquet can be used, the patient should be instructed in the use of local pressure. The third complication that may follow this type of surgery is thrombosis, which may occur at any time from a few minutes to years after operation. The longer that patients having this type of surgery are followed, the higher seems to be the incidence of late thrombosis. In the case of thrombosis occurring after several weeks, however, the limb is seldom lost, whereas thrombosis occurring promptly will frequently result in an amputation. Thrombosis occurring on the venous side of the circulation is usually less troublesome but may give rise to pulmonary emboli as well as local venous stasis. Experience is limited, but the use of fibroinolysin in the early treatment of thrombosis looks promising.

When vascular injuries result in arterial insufficiency in the distal tissue, certain protective measures may be indicated either prior to surgery or after surgery if ischemia persists. These measures include the use of sympathetic nerve block; the proper positioning of the patient so that the ischemic part is slightly dependent; the maintenance of body warmth for its vasodilating effects; the abstinence from tobacco, which will inevitably cause some vasoconstriction; and the protection of the injured part from further trauma.

With the advances that have recently been made in vascular surgery, the chance of restitution of circulation following serious trauma to the major vessels is far greater than in previous times. All surgeons dealing with trauma must be aware of the possibilities that exist today of preservation or restitution of circulation and treat these patients accordingly. We no longer can be satisfied with the preservation of life and limb alone but must consider the preservation of function. The element of time remains of great importance, and unnecessary delay must be avoided. Excellent results have already been achieved in military surgery when dealing with trauma to the major vessels, and we must be certain that we do no less well in civilian life when caring for injuries which often are less severe and more readily handled than those with which our military colleagues have dealt.

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References

1. De Bakey, M. E., and Simeone, F. A.: Battle Injuries of the Arteries in World War II, *Ann. Surg.* 123:534-579, 1946.

2. Hughes, C. W.: Acute Vascular Trauma in Korean War Casualties, *Surg. Gynec. & Obst.* 99:91-100, 1954.

3. Lumpkin, M. B.; Logan, W. D.; Couves, C. W., and Howard, J. M.: Arteriography as an Aid in the Diagnosis and Localization of Acute Arterial Injuries, *Ann. Surg.* 147:353-358, 1958.

4. Jahnke, E. J., Jr., and Seeley, S. F.: Acute Vascular Injuries in the Korean War, *Ann. Surg.* 138:158-177, 1953.

5. Jahnke, E. J., Jr.: Late Structural and Functional Results of Arterial Injuries Primarily Repaired, *Surgery* 43:175-183, 1958.

Toxicology of Some of the Aliphatic and Alicyclic Hydrocarbons

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CHEMICALS are becoming more important in the lives of all physicians. In addition to the multiplicity of chemotherapeutic agents identified by lyric commercial names, and an official nomenclature understood with difficulty, the more conventional chemicals are being used expandingly in industrial and household products. Consequently, workers are potentially exposed to detrimental agents in their business and private lives. Usually, the work environment is controlled by supervisory and professional staffs familiar with the inherent problems, and adequate provision is made for proper handling. The home environmental picture has less favorable features: Commercial agents are misapplied; labelled instructions are not followed, and the instruction labels are lost from partially used containers or the contents are transferred into any available container not properly marked. With memory failure, these materials are subsequently misused or, even worse, left within reach of curious children. Within recent years we have seen the development of "poison centers," where information can be accumulated about various materials and professional persons can obtain information and advice about suspected agents. Although these centers are poor substitutes for appropriate preventive measures, they certainly supply a needed service to professional groups and the lay public.

Whether physicians like it or not, the *present status* will not show a trend toward going back to the "old days," but will become more complex so that the demands for information upon industrial and community-serving physicians will become greater. It would appear that all physicians, from necessity, will have to become more familiar with chemistry and chemical intoxication syndromes. Although this may be a formidable undertaking in a new field of endeavor for physicians, basic information and knowledge can be acquired by understanding the structure of chemical compounds and the relationship of chemical structure and physiological action to clinical symptoms. Another way of stating this is that by learning some chemistry we may understand some toxicology. It is incumbent upon us all to refresh our memories about basic organic chemistry and apply that information to the appreciation of clinical symptomatology.

Chemicals in a class, group, or series often elicit similar symptoms because of similarity of the molecular configuration. An excellent example is the dramatic symptomatology which results from intoxication by the organic phosphorus insecticides which have appeared on the market in the past several years. These insecticides act as inhibitors of the enzyme cholinesterase and allow the accumulation of acetylcholine. Although these compounds have some direct toxic effects, the predominant clinical symptoms are the result of their action on the parasympathetic nervous system. In effect, this is a pharmacological illness and can be treated with the appropriate pharmacological antidote, atropine. In this instance it is not necessary to know specific formulae but it is necessary that we have a knowledge of the general physiological action of a class or series of compounds.

The Meyer-Overton law of partial solubility into lipids may be applied to the aliphatic hydrocarbons to explain their narcotic-anesthetic action.

Ferguson, as reported by Albert,[1] developed the principle of structural nonspecificity of certain hypnotics and general anesthetics whose action is not dependent upon the presence of a particular chemical group but depends upon certain physical properties which make for accumulation. Albert's discussion of this shows

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that substances which are present at the same proportional saturation in a given medium have the same degree of biological activity. This theory is extended to graphically demonstrate the relationship of solubilities of agents to toxic concentrations, which is usually a straight line, and to a straight-line log saturation curve in a homologous series. The frequently observed cut-off point of a toxic state to a nontoxic state by a slight molecular change seems to be explained by the relative solubility of the material in the medium. When the agent under study falls below the saturation line, cellular intoxication cannot occur. This may explain the biological inertness of the lower members of the paraffin series in comparison with the higher members.

Many attempts have been made to correlate some physical property, such as molecular weight, boiling point, or solubility, to toxic effects. General application cannot be made because many agents act chemically, as does HCN, rather than physically. When the action is physical, structural relationships often can be demonstrated, for it has long been known that in many homologous series each succeeding member is more toxic than the preceding one. By using numerical factors for all the atoms and bonds in a molecule, McGowan[2] was able to show that calculated toxic concentrations often approximated experimental levels. However, when toxic effects occur from chemical action, the predicted intoxication dose can be in great error.

In the subsequent paragraphs the general action of the aliphatic hydrocarbons, the chemistry of the four homologous series of these compounds, and representative members in each series will be considered.

Summary of Action

The lower members of the hydrocarbon series, methane and ethane, are physiologically inert but can achieve some anesthetic effects in high concentrations from the associated anoxia. The four-, five-, and six-carbon members have anesthetic and mucous-membrane-irritating properties increasing in the order listed.[3] Von Oettingen,[4] in an extensive review, reported that the margin of safety between narcotic and fatal concentrations is small for the higher members of the series and, consequently, the potential dangers increase with the inhalation of higher concentrations. In the same article it was shown that there is increasing narcosis with increasing unsaturation and also increasing narcosis with increasing molecular weight. This is illustrated in Table I.

Table I—Relation of Narcotic Action to Structure

Compound	Structure	Narcotic Action Vol. %
Propane	$CH_3—CH_2—CH_3$	90
Propylene	$CH_3CH=CH_2$	40
Propadiene	$CH_2=C=CH_2$	20
Cyclopropane	$CH_2—CH_2—CH_2$	15
Ethylene	$CH_2=CH_2$	90
Propylene	$CH_3CH=CH_2$	40
Butylene	$CH_3CH_2CH=CH$	20

Cardiac irregularities have been reported from the anesthetic use of ethylene and cyclopropane. They result from the agent's sensitizing the myocardium to adrenalin. Chenoweth[5] found that methane, butane, hexane, heptane, gasoline, xylene, and toulene also sensitized the mammalian ventricle to epinephrine, resulting in ventricular filbrillation. Other studies[6, 7] have confirmed this observation. Ethylene has a low order of sensitization and is followed by acetylene, the higher members of the unsaturated and alicyclic hydrocarbons, and then the saturated hydrocarbons. It appears that sensitization of the myocardium is disfavored by double and triple bonds in the inhaled hydrocarbon.

Above six carbons the paraffin, ethylenic, and alicyclic hydrocarbons have some herbicidal action, resulting from the compounds' accumulating in plant cell lipids.[8]

Generally, aliphatic hydrocarbons are not thought to have any significant detrimental effect on the hemopoietic system. One abstract of a foreign publication has been noted in which "hyperleucocytosis and polynucleosis" was reported in 54 cases following inhalation of aliphatic hydrocarbons.[9]

The Saturated Hydrocarbons

The saturated hydrocarbons, paraffins, alkanes, or homologs of methane, have the general formula C_nH_{2n+2}. Since in the methane-ethane-propane series the carbon valences are fully saturated with hydrogen, the compounds are called "saturated" hydrocarbons. These substances are characteristically inert, showing little tendency to combine with many reagents;

The chemical information used throughout this article was obtained from Fieser and Fieser[10] and Whitmore.[11]

they are consequently called "paraffin" hydrocarbons (Latin, parum affinis, slight affinity). This homologous series shows the gradation of properties often characteristic of a series. Methane, CH_4, the first member of the group, is a gas with a boiling point about 20°C above oxygen. The repeated addition of $—CH_2—$ produces liquids at C_5 and low-melting solids at C_{16}. The increment increase in boiling point for an increase of $—CH_2—$ decreases with the higher members. Also, branching of the chain to form isomers changes the properties from those observed of the normal (*n*-), or straight chain, member with the same molecular weight. Two compounds that are made up of the same number and kinds of atoms are termed isomers (Greek, the same parts). Of isomers, the normal (straight chain) member has the highest boiling point. In the series to C_8 the *n*-hydrocarbons boil at lower temperatures than the lowest-boiling isomer of the next higher homolog. Thus, all the octanes (C_8) boil at higher temperatures than *n*-heptane (C_7). At this point in the series, the spread between two successive *n*-hydrocarbons becomes so small and the possibility of branching so great, with accompanying lowering of the boiling point, that at least two of the highly branched nonanes boil at lower temperatures than *n*-octane.

The isomers of hexane demonstrate the structural relationship to boiling point (Table II).

Table II—Relation of Boiling Point to Structure

		Boiling Point Degrees C
1	*n*-Hexane	68.7
2	2-Methylpentane	60.3
3	3-Methylpentane	63.3
4	2, 2-Dimethylbutane	49.7
5	2, 3-Dimethylbutane	58.0

By means of a mathematical calculation, the number of isomers of a given C_n value can be determined with reasonable accuracy. The number of isomers which are possible with the addition of each $—CH_2—$ is usually more than a geometric ratio of two. Table III illustrates this point.

The alkanes are practically insoluble in water but are soluble in most organic liquids. They occur in natural gas, petroleum, and vegetable oils. They are used as fuels, as refrigerants, as solvents in paints, enamels, and varnishes, and in degreasing and dry cleaning.

Methane, CH_4, the first of the paraffin series,

Table III—Relation of Number of Isomers to Number of Carbons

Number of Carbons	Number of Isomers
C_6	18
C_7	35
C_{10}	75
C_{15}	4,347
C_{20}	366,319
C_{30}	4,000,000,000+

is a colorless and practically odorless gas. It is a component of natural gas to about 85% and is also found in coal mines, where it is designated "fire damp." It originates from the decomposition of carbonaceous material in marshy places and is then called "marsh gas." Under similar conditions anaerobic bacterial decomposition of vegetable matter in sewage disposal plants yields a gas which may contain as much as 80% methane. The major commercial use of methane is as a heating fuel. Industrially, it is used as a source for the production of carbon monoxide, hydrogen, and carbon black by controlled, incomplete combustion. Methane is biologically inactive. Any observed anesthetic effect probably results from the necessarily accompanying anoxia. Reported fatalities are presumably due to asphyxiation by lack of oxygen rather than from any primary action of the gas.

Ethane, CH_3CH_3, the second of the series, is a colorless and odorless gas. It also is a component of natural gas to about 12% to 15% and is used primarily as fuel. It has little industrial use except in refrigerating systems but is one of the materials used in thermal cracking processes to secure unsaturated hydrocarbons. Ethane is also biologically inactive and has the same asphyxiant-anesthetic action as methane.

Propane, $CH_3CH_2CH_3$, has physical and chemical properties similar to the preceding members of the series and is a constituent of natural gas. Under several commercial names, it is sold as a household and equipment fuel source. Industrially, it is used in refrigerating systems, as a fuel for internal combustion engines and a material for thermal cracking in the production of unsaturated compounds. It has mild anesthetic properties in high concentrations (90%) which may be accounted for partially by the relative anoxia.

As with other gases held under pressure, cooling takes place when propane is relased into ordinary atmospheric conditions. Hubbard and Johnston[17] reported the case of a farmer exposed to propane for one to three minutes while

transferring the chemical into a tractor tank. Discomfort of his hands led to his hospitalization within an hour. Immediate brachial blocks gave temporary improvement but did not prevent edema and blistering of the skin within one day and subsequent gangrene necessitating amputation of four fingers about 10 days later. Although frostbite is not uncommon among personnel working with liquid propane, the serious consequences as reported in this case are certainly unusual.

Since the higher members of this series are frequently not encountered in pure form except in isolated cases where heptane or hexane is used as an industrial solvent, the whole group may be considered as mixtures as represented by gasoline and kerosene. Unfortunately, these materials do not have any constant composition, but are complex mixtures of C_5 to C_9 hydrocarbons and often contain indefinite amounts of aromatic compounds of the benzene type and five- and six-carbon saturated and unsaturated cyclic compounds. Since the toxicology of the aromatic series is different from that of the aliphatic group, particularly as it relates to the hemopoietic system, some intoxication symptoms properly part of benzene (benzol) exposures have been attributed to the paraffin group. As previously mentioned, aliphatic compounds and mixtures are narcotic, solvent, and irritating agents and any suppressing effect on blood formation is slight.

Many terms have appeared in the literature to identify various petroleum fractions. Even when the same terms are used, the materials, as identified by boiling range, may differ. The following definitions are based upon a publication of the American Standards Association.[13]

Benzine is archaic and misleading and should not be used. Petroleum benzine (benzin) should only be used for material meeting the United States Pharmacopoeia XIV specifications. ("Petroleum Benzin" is no longer official in the United States Pharmacopoeia but is official in the National Formulary.) The term benzine should never be used without the prefix "petroleum."

Gasoline is a refined petroleum naphtha which, by its composition, is suitable for use as a carburant in internal combustion engines.

Kerosine* is a refined petroleum distillate suitable for use as an illuminant when burned in a wick. The flash point may not be below 73°F (23°C).

Ligroine is saturated petroleum naphtha boiling in the range 20° to 135°C and is suitable for general laboratory use. This term should be used instead of benzine or petroleum ether. Petroleum ether is misleading and should not be used.

Petroleum naphtha is a generic term applied to refined, partly refined, or unrefined petroleum products and liquid products of natural gas, not less than 10% of which distills below 175°C and not less than 95% of which distills below 240°C.

Petroleum spirits (mineral spirits) is a refined petroleum distillate with volatility, flash point, and other properties making it suitable as a thinner and solvent in paints, varnishes and similar products.

Gasoline and kerosene composition varies widely. It is dependent upon the source of the crude petroleum, the manufacturing process, added anti-knock agents, and blended materials to raise the octane rating and control the burning rate. Since the boiling points of gasoline and kerosene are high and the vapor pressures low, inhalation intoxication is not common when one considers the extensive use of these materials. However, gasoline being the more volatile, has caused severe intoxications and death by inhalation probably from its narcotic effect and severe depression of the central nervous system. As with other anesthetic agents, a stage of stimulation and excitement is observed. The order of symptomatology is headache, nausea, lightheadedness, excitement and confusion. As anesthesia progresses, involuntary muscular movements and frank convulsions may appear. Death results from respiratory failure.

A severe and commoner problem is the ingestion of gasoline and kerosene, particularly by children. In 1947 Daeschner, Blattner, and Collins[14] reported 149 cases and reviewed the literature.

Coughing, choking, and gagging are often noted at the time of ingestion of the hydrocarbon mixture. Respiratory embarrassment may be present early, indicating that aspiration has taken place. They report that information available from the histories indicated that aspiration had taken place in 95% of the cases prior to the time they were seen by a physician. Epigastric discomfort appears and is often followed by vomiting with the further risk of aspiration. Soon there is evidence of central nervous system involvement with lethargy, convulsions and coma. Physical examination may reveal very little, but roentgenological studies reveal an early peribronchial pneumonitis in a large number of cases, sometimes as soon as thirty minutes after ingesting the material. They state that if serial x-ray

*This is the spelling used by the American Standards Association. Since "Kerosene" is preferred by Webster, it will be used elsewhere in this review.

examinations are made, the majority of the children will show patchy pneumonitis involving both lung fields within the first 12 hours. Later progressive bacterial pneumonia tends to develop. With supportive and antibiotic therapy, they report a mortality rate of 1.3%. The mortality rate in other series ranges from 4% to 10%.

The question of whether or not ingested petroleum hydrocarbons can cause pulmonary pathology without aspiration is controversial, for there is experimental evidence for and against the development of a chemical pneumonitis via the blood stream. The question is academic for Daeschner reports that, of the deaths recorded, all are due to severe pulmonary involvement and none solely to injury of the central nervous system. Since small amounts of kerosene, 1 to 2 cc, instilled intratracheally can cause severe or fatal pulmonary pathologic change and large amounts, 20 to 30 cc per kilogram, may be safe by ingestion if there is no aspiration, gastric lavage may be unnecessary and probably dangerous because of the associated risk of aspiration during lavage.

The cutaneous effects of gasoline result from its solvent action. By defatting, the skin becomes more susceptible to other irritants, sensitizing agents and bacteria. Anderson[15] reported that primary irritation and defatting by petroleum products decreases as the boiling range increases. Sensitization to gasoline can occur,[16] but it is not common. Waterless hand cleaners which contain significant quantities of aliphatic hydrocarbons have caused dermatitis.[17]

Ethylenic Hydrocarbons

The hydrocarbons of this series are also called alkenes, unsaturated hydrocarbons, and "olefins" (oil-forming substances). They are characterized by the presence of a double bond in the molecule and differ very little from the saturated hydrocarbons, or alkanes, in physical properties but contrast sharply with them in chemical properties. They have the general formula C_nH_{2n}, having two less hydrogens than the corresponding alkanes. They are highly reactive, combining with many materials at room temperature to form addition products. Because of reactivity, they usually do not occur in natural products. The nomenclature is more complex than that of the alkane series. Many are known by their common names—ethylene ($CH_2=CH_2$), propylene ($CH_3CH=CH_2$), or substitutions of ethylene, as isopropyl ethylene [$(CH_3)_2CHCH=CH_2$], and dimethyl ethylene ($CH_3CH=CHCH_3$). The Geneva system of nomenclature indicates an ethylenic hydrocarbon by changing the paraffin ending -ane to -ene. Beyond three carbons the unsaturation can be in more than one place, and its location is indicated by a number at the end of the name. Thus, the series becomes ethene, propene, butene, pentene, etc. The butenes are butene-1 ($CH_3CH_2CH=CH_2$) and butene-2 ($CH_3CH=CHCH_3$), and isobutene ($\begin{pmatrix} C—C=C \\ \quad\ C \end{pmatrix}$). The prefix iso- means isomeric.

As indicated above, the physical properties vary only slightly from those of the corresponding saturated compounds. The first three members are gases, those with 5 to 18 carbons are liquids, and the higher homologs are solids.[18]

Some members of the ethylenic series contain more than one unsaturation in the chain. These compounds are called dienes or diolefins. The simplest of the series is propadiene or allene ($CH_2=C=CH_2$), followed by butadiene-1,2 ($CH_3CH=CH=CH_2$), and butadiene-1,3 ($CH_2=CH—CH=CH_2$). Another important member of the series is isoprene, methyl butadiene ($\begin{pmatrix} CH_2=C—CH=CH_2 \\ \quad\quad\ | \\ \quad\quad CH_3 \end{pmatrix}$). The last two are of importance in the manufacture of synthetic rubber.

Ethylene, $CH_2=CH_2$, is the first member of the alkene series. It is formed by vapor phase cracking of petroleum and the heavier fractions of natural gas. It has extensive industrial use as a raw material because of the ease with which addition products can be made to yield such important industrial chemicals as ethyl alcohol, ethylene oxide, the ethylene amines, ethylene glycol, halogenated compounds, and polyethylene plastics.

Ethylene has a biological effect on fruits and vegetables, and is used in blanching vegetables, as in the case of celery, and maturing the color of citrus fruits, bananas, and melons.

Since Luckhard's[19,20] work in 1923, ethylene has received wide acceptance as an anesthetic agent. It has a slightly sweet taste and a slight, but not unpleasant odor. Goodman[21] states that ethylene-oxygen mixtures produce satisfactory anesthesia with practically no effect on vital functions. The innocuousness of ethylene on tissues is its outstanding advantage. It is excreted in the exhaled air without any chemical change in the body. As an anesthetic agent, it is more potent than nitrous oxide but less potent than the agents rated 100%, namely, ether, chloroform, divinyl ether, and cyclopropane. Induction is rapid, although the patient may have a sense of suffocation. Since it is not irritating to mucous membranes, bronchial

secretions are not troublesome. Satisfactory surgical anesthesia can be maintained with an 80:20 ethylene-oxygen mixture. Since ethylene is not a respiratory depressant, the respirations tend to remain normal during anesthesia. Cardiac arrythmias may occur but not as frequently as with other anesthetic agents, and there is no impairment of cardiac, renal, or hepatic functions. Ethylene seems to be a benign anesthetic as long as a state of anoxia is not produced. Anoxia is probably the cause of any symptoms resulting from ethylene anesthesia. The one great disadvantage of ethylene is its explosiveness. It has explosive limits of 2.75% to 28.6% by volume.[22] Accidents and fatalities have occurred. Goodman states that the most critical time is at the end of anesthesia when ethylene is discontinued. The exhaled mixture remains in the explosive range for three to four minutes after ethylene is stopped. Another disadvantage is that during anesthesia there is an increased bleeding tendency, which ceases when the anesthesia is over.

Propylene, propene, $CH_3CH{=}CH_2$, is also secured by the cracking of petroleum. It enters into the same type of reactions as ethylene, yielding isopropyl alcohol, propylene oxide, propylene glycol, propylene amines, and so on. Von Oettingen[4] summarized the published animal anesthetic studies. Propylene appears to be about 2.25 times as potent as ethylene. There is considerable species variation, for in dogs the narcotic dose was equal to the fatal dose.

The higher molecular weight alkenes have increasing narcotic action and increasing toxicity with increasing molecular weight.[4] If the narcotic action of ethylene is 1, propylene is 2.25 times as potent, butylene 6 times, and amylene 15.5 times as potent as ethylene.

Butadiene-1,3 has very extensive use in the manufacture of synthetic rubber. Carpenter, et al.[23] studied the effect of butadiene on several animal species. Rabbits exposed to 25% butadiene in air were anesthetized in an average time of 1.6 minutes. Repeated exposures for seven and one-half hours a day, six days a week for eight months to 6,700 ppm (parts per million) did not cause any body injury or any change in the blood picture. Men exposed for eight hours to 8,000 ppm noted only the odor and slight irritation. The authors' statement that butadiene is practically innocuous aside from its narcotic action at very high concentrations seems to be verified by the lack of cases of intoxication reported in the literature.

Acetylenic Hydrocarbons

Acetylenic hydrocarbons, also called alkynes, are characterized by the presence of a triple bond, —C≡C—, and have the general formula C_nH_{2n-2}. The simplest member is acetylene ($HC{\equiv}CH$) which has two fewer hydrogens than ethylene and thus bears the same relationship to ethylene as ethylene does to ethane. The higher degree of unsaturation is associated with greater chemical reactivity. Other members of the series are often named as derivatives of the parent hydrocarbon, as methyl acetylene ($CH_3C{\equiv}CH$), ethyl acetylene ($CH_3CH_2C{\equiv}CH$), and dimethyl acetylene ($CH_3C{\equiv}CCH_3$). In the Geneva system an acetylenic hydrocarbon is indicated by the ending -yne or -ine. Therefore, methyl acetylene is propyne and dimethyl acetylene is butyne-2.

The physical properties are similar to those of the other aliphatic hydrocarbon series.

Acetylene, C_2H_2, narcylene, is formed by the action of water on calcium carbide, by the pyrolysis of methane, and by cracking petroleum and natural gas fractions. Prior to the development of lamp batteries, acetylene generators using calcium carbide served as a source of illumination on vehicles. Today, the main uses of acetylene are in chemical synthesis and in oxyacetylene welding. Under certain conditions acetylene explodes readily when compressed; so it is stored and transported in cylinders containing acetone, in which it is soluble to the extent of 25 volumes at 1 atmosphere and 300 volumes at 10 to 12 atmospheres. Acteylene reacts with certain metals to form metallic acetylides, which are explosive.

Acetylene has been used as an anesthetic agent, particularly in Europe, but is more explosive than and not so satisfactory as ethylene. However, it is more potent, for 35% by volume gives the same degree of narcosis as 60% by volume of ethylene.[4] Acetylene is absorbed rapidly from the lungs and exhaled unchanged, not being metabolized in the body, and does not appear to have any organic effects. Because of its wide flammable range, 2.5% to 80.0% by volume in air,[22] acetylene is much more hazardous than ethylene as an anesthetic agent.

Acetylene has found use as a gas for the determination of cardiac output.[24] By breathing a 20% to 25% acetylene-air mixture, and making gas analyses, the volume of the cardiac output can be calculated. Total rebreathing lasts for about 20 seconds.

Pure acetylene is practically odorless, but many commercial preparations contain impurities which impart an odor to it. These impurities, hydrogen sulfide and phosphine, also contribute to observed symptoms of toxicity.

Methyl acetylene,[29] $CH_3C{\equiv}CH$, propyne, or

allylene, is a colorless gas which is formed by the pyrolysis of hydrocarbons. It can be used as a substitute for acetylene in welding, although its flame temperature is considerably lower, being 2300°C, in comparison with that of acetylene, which is 3200°C. It also forms metallic acetylides with copper, silver, and mercury which are explosive.

In animals, methyl acetylene has surgical anesthetic properties at 10% to 15% concentrations. The induction is slow, and muscular motion does not cease until a state of respiratory depression is reached. Cardiac irregularity may appear and death results from respiratory failure.

The results of biochemistry and pathology studies, as reported by Horn,[29] were normal except for pulmonary edema and alveolar hemorrhage following acute exposures and bronchitis and pneumonitis with secondary bacterial infection following chronic exposures.

Alicyclic Hydrocarbons

The alicyclic, or polymethylene, compounds, as the name indicates, are cyclic and have aliphatic properties. Cyclopropane is the first member of the series and is followed by cyclobutane, cyclopentane, and cyclohexane. Multiple substitution products can be made by displacing one or more hydrogens of the ring by side-chains. Cyclopropane, C_3H_6, is an isomer of propylene, C_3H_6.

Corresponding to the ethylenic series, unsaturation can exist in the ring, the first of the series being cyclobutene. Double unsaturation begins with the five-carbon member, cyclopentadiene.

Polycyclic compounds of extensive complexity occur naturally in petroleum, terpenes, and camphors, as well as the cholane nucleus in bile acids, sterols, and digitalis.

Cyclopropane, trimethylene, CH_2,CH_2,CH_2, is the simplest of the cycloparaffins. It is a colorless gas with a pungent but not unpleasant odor. It is stored as a liquid under pressure and is stable. The gas is heavier than air and is explosive in air from 3% to 8.5% and in oxygen from 2.5% to 50%.

The primary use of cyclopropane is in surgical anesthesia, and it is the most potent of the anesthetic gases. Goodman[21] lists reports showing that analgesia occurs with concentrations of 3 to 5 vol. %. By use of preanesthetic medication, the volume required to produce plane two anesthesia is decreased from 26% to 13%. The concentration of cyclopropane required for surgical anesthesia is so low that adequate oxygen can always be given, and there is a wide margin between anesthetic and toxic concentrations.

Induction into anesthesia is rapid and pleasant. It is not irritating to the respiratory tract, and so salivation and bronchial secretions are not troublesome. However, only a trained anesthetist should administer cyclopropane, for the depth of anesthesia is difficult to judge because pupillary dilatation is slight and late, skin color is good because of the high oxygen content, and there is no change in respiratory movements until respiratory depression occurs. With cyclopropane, the best warning signs of toxicity are bradycardia, tachycardia, or arrhythmias. Cardiac irregularities increase with the depth of the anesthesia, in contrast to ether, which has a decreasing incidence with depth of anesthesia.

In addition to the cardiac effect of cyclopropane, it is explosive throughout the entire range of anesthetic concentrations. However, this is less of a problem than is the case with ethylene.

Cyclohexane, hexamethylene, hexahydrobenzene, C_6H_{12}, occurs naturally in petroleum and is formed by the catalytic hydrogenation of benzene. It is a colorless liquid with a somewhat sweet odor and is used as a paint thinner and degreasing agent. Cyclohexane is a narcotic in high concentrations, death resulting from respiratory paralysis. Chronic toxic effects have not been demonstrated from the pure product in animals except at high concentrations.[25] Cyclohexane has been recommended as a replacement for benzene,[26] but care should be exercised in its use, for commercial cyclohexane may contain benzene.[27, 28] In animals cyclohexane is excreted in the urine as a conjugated sulfate,[25] and this determination may serve as an index of human exposures.

Summary and Comment

In the preceding paragraphs a brief review of the chemistry of the aliphatic hydrocarbons is presented along with a discussion of some of the members of each homologous series. Data of human exposures to many members of the series are not available, and experimental work performed by different observers using different techniques is compared with difficulty. Information is needed concerning human exposures to these materials so the clinical syndromes can be clarified.

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References

1. Albert, A.: Selective Toxicity. New York, John Wiley & Sons, Inc., 1951.

2. McGowan, J. C.: Physically Toxic Chemicals and Industrial Hygiene, *A.M.A. Arch. Indust. Health* 11: 315, 1955.

3. Hazlett, T. L. (Editor): Introduction to Industrial Medicine, Chicago, Industrial Medicine Publishing Co., 1947.

4. von Oettingen, W. F.: Toxicity and Potential Dangers of Aliphatic and Aromatic Hydrocarbons, Public Health Bulletin No. 255, 1940.

5. Chenoweth, M. B.: Ventricular Filbrillation Induced by Hydrocarbons and Epinephrine, *J. Indust. Hyg. & Toxicol.* 28:151, 1946.

6. Krantz, J. C., Jr.; Carr, C. J., and Vitcha, J. F.: Anesthesia: XXXI. A study of Cyclic and Non-Cyclic Hydrocarbons on Cardiac automaticity, *J. Pharmacol. & Exper. Therap.* 94:315, 1948. (Chem. Abst. 43, 1949.)

7. Carr, J. F.; Burgison, R. M.; Vitcha, J. F., and Krantz, J. C.: Anesthesia: XXXIV. Chemical Constitution of Hydrocarbons and Cardiac Automaticity, *J. Pharmacol. & Exper. Therap.* 97:1, 1949. (Chem. Abst. 44, 1950.)

8. Currier, H. B., and Peoples, S. A.: Phytotoxicity of Hydrocarbons, *Hilgardia* 23:155, 1954. (Chem. Abst. 3191. 50, 1956.)

9. Mignolet, F.: Hydrocarbon Pathology, *Arch. mal. profess.* 13:454-7, 1952; *Chémie et industrie* 69:471, 1953. (Chem. Abst. 6510. 49, 1955.)

10. Fieser, L. F., and Fieser, M.: Organic Chemistry, D. C. Heath & Co., Boston, 1944.

11. Whitmore, F. C.: Organic Chemistry, New York, D. Van Nostrand Co., Inc., 1937.

12. Frostbite Due to Propane, Correspondence, *J.A.M.A.* 157:1579, 1955.

13. Standard Definitions of Terms Relating to Petroleum, Approved as American Standard by the American Standards Association, ASA No. Z11.28, 1957.

14. Daeschner, C. W., Jr.; Blattner, R. J., and Collins, V. P.: Hydrocarbon Pneumonitis, *Pediat. Clin. North America* (Feb.) 1957.

15. Anderson, N. P.: Contact Dermatitis: Its Relation to Petroleum Products, *Indust. Med. & Surg.* 22: 270, 1953.

16. Biederman, J. B.: A Case of Contact Dermatitis Produced at a Distance by the Sensitizing Agent; *J.A.M.A.* 106:2236, 1936.

17. Morris, G. E.: Dermatitis from Waterless Hand Cleaners; *A.M.A. Arch. Indust. Hyg.* 9:507, 1954.

18. Fairhall, L. T.: Industrial Toxicology, Baltimore, Williams & Wilkins Company, 1957.

19. Luckhard, A. B., and Carter, J. B.: The Physiological Effects of Ethylene, *J.A.M.A.* 80:1440, 1923.

20. Luckhard, A. B., and Lewis, D.: Clinical Experiences with Ethylene-Oxygen Anesthesia, *J.A.M.A.* 81:1851, 1923.

21. Goodman, L., and Gilman, A.: The Pharmacological Basis of Therapeutics, New York, The Macmillan Company, 1941.

22. Patty, F. A. (Editor): Industrial Hygiene and Toxicology, Vol. II, New York, Interscience Publishers, Inc., 1949.

23. Carpenter, C. P.; Shaffer, C. B.; Weil, C. S., and Smyth, H. F., Jr.: Studies on the Inhalation of 1,3-Butadiene, with a Comparison of Its Narcotic Effect with Benzol, Toluol and Styrene, and a Note on the Elimination of Styrene by the Human. *J. Indust. Hyg. & Toxicol.* 26:69. 1944.

24. Best, C. H., and Taylor, N. B.: The Physiological Basis of Medical Practice. Baltimore, Williams & Wilkins Company, 1950.

25. Treon, J. F.; Crutchfield, W. E., Jr., and Kitzmiller, K. V.: The Physiological Response of Cyclohexane, Methyl Cyclohexane and Certain Derivatives and their Compounds, *J. Indust. Hyg. & Toxicol.* 25:199, 1943.

26. Fabre, R.; Truhaut, R., and Peron, M.: Toxicological Studies of Solvents Replacing Benzene: I. Cyclohexane, *Arch. mal. profess.* 13:437, 1952. (*Indust. Hyg. Digest* 471, May, 1953.)

27. Truhaut, R.: Toxicity of Commercial Cyclohexane: The Part Played by Impurities, *Arch. mal. profess.* 14: 497, 1953. (*Ind. Hyg. Digest* 622, June, 1954.)

28. Tara, S.: The Toxicity of Cyclohexane; *Arch. mal. profess.* 14:494, 1953. (*Ind. Hyg. Digest* 621, June, 1954.)

29. Horn, H. J.; Weir, R. J., Jr., and Reese, W. H.: Inhalation Toxicology of Methylacetylene, *A.M.A. Arch. Indust. Health* 15:20, 1957.

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Topical Review

Industrial Medical Aspects of Nuclear Technology

Niel Wald, M.D., Pittsburgh

This is the first of a series of twelve reviews. Subsequent installments are scheduled to appear at quarterly intervals.

PRACTITIONERS of industrial medicine and occupational health have accepted an extremely demanding role in our present-day society. To fulfill their responsibilities creditably, they must keep abreast of new developments in two of the most rapidly changing fields of modern human activity, medical practice and industrial technology. When one considers that 90% of the 750,000,000 prescriptions now written yearly are for medications and products not available even 10 years ago,[1] one can obtain some concept of the rate of change in medical practice. For an example of developments in industrial technology, one need but to view a representative specialized area such as that of nuclear technology, which has mushroomed amazingly since its recent birth in 1940. The United States Government's investment alone in the Atomic Energy program involved $19,500,000,000 in appropriated funds through fiscal year 1958 with an A.E.C. equity of about $9,000,000,000 remaining after operating expenditures.[2] The four years since passage of the Atomic Energy Act of 1954 have been characterized by similarly fast growth of the private atomic energy industry.

It is evident that the individual mind cannot possibly digest and absorb all the details contributing to and arising from these rapid developments. One must simply adhere to certain reliable general principles and add only those specific facts which are essential to the satisfaction of one's own responsibilities. Thus, the general principles of the industrial medical approach to new forms of technology and therapy have not changed drastically, although the new techniques involved may themselves be quite unfamiliar. The worker must still be fitted to a job whose performance will not endanger his health or that of his fellow worker. Environmental control, individual medical supervision, and education are still the means by which health is maintained, with appropriate therapy reserved for the instances where these means fail.

It has been possible, therefore, in many situations for the general industrial physician to carry out his duties well by acquiring new information and discarding the old in step with the technological developments in the area of his responsibility. However, there are certain aspects to the problem of understanding and managing radiation exposure in industry which make self-education a bit difficult. The rather special properties of radiation itself, such as the inability of sense organs to detect it, the long latency of some of its damaging effects, the cumulative and sometimes irreversible nature of its action, the possible genetic effect which involves descendants of the workers, and the relative deficit of data concerning human prophylaxis and therapy, make it a somewhat unfamiliar problem. Also, the vocabulary and concepts of nuclear physics are not readily acquired. In addition, the speed of accumulation of new knowledge in this specialized field has been so great that it is not easy to find a usable compilation of the important details for which an industrial physician might feel a need, in a context which is meaningful to other than a specialist in the field of nuclear radiation.

The increasing magnitude of this problem is apparent when one notes that by December, 1957, about 1,600 industrial organizations already were authorized to use radioisotopes for industrial purposes, including 250 of the 500 largest corporations in the country. Atomic Energy Commission studies indicate that about

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15 times that number could profitably do so, and the Commission has initiated an isotope-development program to bring this about. It is thus inevitable that many more industrial physicians will join those already confronted with the medical responsibility for this potential health hazard. Where will they find the basic information which is needed about radioactivity, radiobiology, health physics, nuclear medicine, and the like, presented from the standpoint of public and occupational health?

A series of topical review articles has been prepared for publication in this Journal to increase the availability of background data about the field of nuclear technology as it concerns the practitioner of industrial medicine and occupational health. Of necessity the approach will be somewhat didactic where presentation of controversial and conflicting data would require specialized knowledge for interpretation.

Among the topics to be discussed in this series are the following:

I. Glossary of technical terms
II. Some fundamentals of nuclear physics, health physics and radiation measurements
III. Sources and applications of nuclear energy in industry
IV. Biological effects of radioactivity at the level of the molecule, cell, tissue, organ and organism
V. Human radiobiology: the acute and chronic effects of acute and chronic radiation exposure, including their detection, prophylaxis and therapy
VI. Permissible exposure limits and their medicolegal significance

Additions, rearrangements, and deletions in this listing will be made in accordance with the basic objective of the series. That objective is to provide the increasing number of industrial physicians facing the new hazard of radioactivity with enough detailed information to facilitate its proper control in accordance with the time-honored principles of industrial medical practice.

I. Glossary of Technical Terms

Since the very vocabulary of the field of nuclear technology is a rather new one, a list of definitions* of some of the most frequently used terms which will be employed in this series should be helpful. Among them will be found familiar terms utilized in somewhat unusual fashion as well as strange ones. Relevant terms in both medical and nuclear science which are generally well known have been omitted.

Although such a glossary usually appears at the end of scientific publications in book form, it is thought that its presentation at the outset of this series will be of greater value.

Absorption. A process by which the amount of radiation is decreased or attenuated as it passes through matter, due to interaction with the atoms therein upon which it impinges.

Accelerator. An apparatus which gives large kinetic energy to such nuclear particles as electrons, protons, deuterons and helium ions. Common types include the cyclotron, synchrotron, synchrocyclotron, betatron, linear accelerator, and Van de Graff electrostatic generator.

Activation analysis. A technique in which unknown materials are identified by the characteristics of the radioisotopes produced when they are subjected to nuclear bombardment.

Acute exposure. Radiation exposure over a short-time period, as opposed to chronic or long-term exposure.

Air dose. Radiation dose expressed as roentgens of gamma or x-rays delivered at a point in free air.

Alpha particle. A strongly ionizing but poorly penetrating form of radiation composed of a helium nucleus, positively charged. A stream of these is an alpha ray. Symbol, α.

Atom. Smallest stable particle of an element.

Atomic number (Z). Number of protons in the nucleus of an atom.

Atomic power. At present refers to nuclear reactor-produced thermal power.

Atomic waste. The radioactive fission product "ashes" from spent or depleted fuel elements of the nuclear reactor "furnace."

Atomic weight. Relative weight of an atom compared to that of an oxygen atom, taking the latter as 16.

Attenuation. The decrease in amount of radiation due to absorption and scattering by intervening matter.

Autoradiograph. Record of radiation from radioactive material in an object, made by placing its surface in close proximity to a photographic emulsion.

Background (radiation). Environmental radioactivity other than that under observation. Due to cosmic rays, naturally present radioactive materials and, in some instances, sources of radioactivity in the vicinity.

Beta particle. A less strongly ionizing, more penetrating charged nuclear particle than the alpha, having mass and charge equal to an electron. A stream of these is a beta ray. Symbol, β.

Biologic half-life (radiobiology). The time in which a living tissue, organ, or individual eliminates, through biologic processes, one-half of a given amount of a substance which has been introduced into it.

Burial ground or Graveyard (reactor engineering). A place for burying unwanted radioactive objects to prevent escape of their radiations, the earth acting as a shield. Such objects must be placed in watertight, non-corrodible containers so that the radioactive material cannot be leached out and get into an underground water supply.

Chain reaction. A reaction in which one of the agents necessary to the reaction is itself produced by the reaction so as to cause like reactions. In the neutron-fission chain reaction, a neutron plus a fissionable atom causes a fission resulting in a number of neutrons which in turn cause other fissions.

*Extracted, with some modifications, from "A Glossary of Terms in Nuclear Science and Technology," N1.1-1957,[3] with permission of the editor, The National Academy of Sciences, and of the publisher, The American Society of Mechanical Engineers, 29 W. 39th St., New York 18.

Contamination, radioactive. A condition in which radioactive material has spread to places where it may harm persons, spoil experiments, or make products or equipment unsuitable or unsafe for some specific use.

Control rod. Any rod used to control the reaction rate in a nuclear reactor, which it does by changing the effective multiplication constant and hence the reaction rate's time derivative. It may be a fuel rod or a part of the moderator; in thermal reactors it commonly is a neutron absorber. Cadmium and boron (in the form of boron steel) are suitable absorbing materials. The term includes *power control rod, regulating rod, safety rod, shim rod.*

Core. In a nuclear reactor, the region containing the fissionable material or the body of fuel or moderator and fuel in the reactor. It does not include the fuel outside the active section in a circulating reactor.

Cosmic rays. Radiation that has its ultimate origin outside of the earth's atmosphere, that is capable of producing ionizing events in passing through the air or other matter, and that includes constituents capable of penetrating many feet of material such as rock.

Count (radiation measurements). The external indication of a device designed to enumerate ionizing events. It may refer to a single detected event or to the total registered in a given period of time. The term is loosely used to designate a disintegration, ionizing event or voltage pulse.

Counter. A device for counting ionizing events. The term may refer to a complete instrument or loosely to the detector.

Counting-rate meter. A device which gives a continuous indication of the average rate of ionizing events.

Critical (reactor theory). Capable of sustaining (at a constant level) a chain reaction. *Prompt-critical* is capable of sustaining a chain reaction without the aid of delayed neutrons.

Critical experiment (reactor engineering). Experiment in which fissionable material is assembled gradually until the arrangement will support a self-sustaining chain reaction; its purpose is to determine the critical size and operating and control features of a proposed reactor or of a new reactor prior to operation. It is carried out at substantially zero power so that forced cooling is unnecessary and fission-product activity is negligible. Such quantities as critical mass, temperature coefficient of reactivity and control rod effectiveness are often measured.

Criticality hazard. Radiation hazard arising from the accidental aggregation of sufficient fissionable material to permit an uncontrolled chain reaction to occur.

Cross section or σ (reactor theory). For a given event, the probability per unit flux and per unit time, that the event will occur. For any collision reaction between nuclear or atomic particles or systems, δ is an area such that the number of reactions taking place is equal to the product of the number of incident particles which would pass through this area at normal incidence and the number of target particles or systems.

Daughter. A nuclide formed in the radioactive decay of another (called the *parent*). A synonym for *decay product.*

Decontamination. The removal of undesired dispersed radioactive material from personnel, instruments, rooms, equipment, etc. In the case of physical objects this may involve thorough washing, often with chemical solutions; and in the case of fluids such as air, it may involve filtering and washing.

Delayed neutrons. Neutrons emitted by excited nuclei formed in a radioactive process (*beta disintegration,* in all cases so far known), so called because emitted an appreciable time after the fission.

Densitometer. Instrument for measuring photographic density, used in film badge monitoring.

Depleted material. Material in which the amount of one or more isotopes of a constituent has been reduced by an isotope separation process or by a nuclear reaction (e.g., uranium depleted in U^{235}).

Disintegration. A spontaneous nuclear transformation (radioactivity) characterized by the emission of energy from the nucleus. When numbers of nuclei are involved, the process is characterized by a definite half-life.

Disintegration, nuclear. Any transformation or change involving nuclei. If the disintegration is spontaneous, it is said to be *radioactive;* if it results from a collision, it is said to be *induced.*

Dose or dosage (radiobiology). According to current usage, the radiation delivered to a specified area or volume or to the whole body. Units for dose specification are roentgens for x- or gamma rays, reps or equivalent roentgens for beta rays. The subject of dose units for particulate radiation and for very high energy x-rays has not been settled. In radiology the dose may be specified in air, on the skin, or at some depth beneath the surface; no statement of dose is complete without specification of location. The entire question of radiation dosage units is under consideration by the International Congress of Radiology, and it is expected that new units, such as the rad, based on the energy absorbed will be adopted.

Efficiency (counters). A measure of the probability that a count will be recorded when radiation is incident on a detector. Usage varies considerably, hence it is well to make sure which factors (window transmission, sensitive volume, energy dependence, etc.) are included in a given case.

Enrichment (reactor theory). Any process which changes the isotopic ratio; in reference to uranium, it is a process which increases the ratio of U^{235} in uranium by separation of isotopes.

ev. The symbol for electron volt. Kev=1000 ev. Mev=1,000,000 ev.

Film badge. An appropriately packaged photographic film for detecting radiation exposure of personnel; usually dental-size x-ray film, worn on the person, and frequently combined with an identification badge. The badge may contain two or three films of different sensitivity, and it may contain filters which shield part of the film from certain types of radiation.

Fission, nuclear. The division of a heavy nucleus into two approximately equal parts. For the heaviest nuclei the reaction is highly exothermic, the release of energy being about 170 Mev per fission. A well-known example is the fission of the compound nucleus formed when U^{235} captures a slow neutron. Other examples are the fissions U^{233} and Pu^{239} by the capture of slow neutrons.

Fission neutrons. Neutrons that are emitted as a result of nuclear fission. *Prompt fission neutrons* are those that are emitted during fissions. *Delayed fission neutrons* are those emitted by fission products.

Fission poisons. Fission fragments which have appreciable capture cross section for neutrons.

Fission products. The nuclides produced by the fission of a heavy element nuclide, such as U^{235} or PU^{239}. Thirty-five fission product elements from zinc through gadolinium have been identified from slow neutron fission.

Flux. For electromagnetic radiation, the power, or energy per unit time, passing through a surface.

For particles or photons, the number passing through a surface per unit time.

Fuel rod (reactor engineering). A rod-shaped body of nuclear fuel or a long-slender fuel assembly prepared for use in a reactor. Short fuel rods are called slugs.

Fusion, nuclear, or thermonuclear. The fusion of light nuclei to form more complex nuclei with an attendant release of energy resulting from a conversion of matter.

Gamma ray or γ ray. A quantum of electromagnetic radiation emitted by a nucleus, each such photon being emitted as the result of a quantum transition between two energy levels of the nucleus. Gamma rays have energies usually between 10 kev and 10 Mev, with correspondingly short wavelengths and high frequencies. They are often associated with alpha and beta radioactivity, following transitions that leave the product nuclei in excited states; in general, they are more penetrating than alpha or beta particles.

Gram-roentgen (radiobiology). The unit is defined by Mayneord as the real energy conversion when a dose of 1 roentgen (r) is delivered to 1 gm of air (about 84 ergs). The unit is employed, however, to describe total energy absorption by the patient in the course of therapy. The quantity obtained by integrating gram-roentgens throughout a region is called the integral dose. Thus, the integral dose, measured in gram-roentgens, resulting from irradiation of a patient with 1 r of x-rays, will vary with the quality of the radiation, the size of the fields, and the thickness of the part.

Half-life. The average time ($t\frac{1}{2}$) required for the decay of one-half the atoms of a sample of a radioactive substance. Each radionuclide has a unique half-life, which is related to its *disintegration constant* as follows:

$$t\,\frac{1}{2} = \frac{0.693}{\lambda}$$

Half-life, effective (radiobiology). Half-life of a radioactive isotope in a biological organism, resulting from the combination of radioactive decay and biological elimination.

$$\text{Effective half-life} = \frac{\text{Biological half-life} \times \text{Radiological half-life}}{\text{Biological half-life} + \text{Radiological half-life}}$$

Health physics (radiobiology). A term in common use for that branch of radiological physics dealing with the protection of personnel from harmful effects of ionizing radiation. It includes the routine procedures of radiation protection surveys, area and personnel monitoring, the recommendation of appropriate protective equipment and procedures, the determination of acceptable standards of operation, and the solution of problems incident to the effective and practical protection of all persons from harmful effects of radiation. Out of this last phase has grown the study of environmental hazards, including the accumulation of radioactive material by plants and animals, and possible injury to human beings ultimately utilizing these in food.

I.C.R.P. International Commission on Radiological Protection.

Induced radioactivity. Radioactivity that is produced by nuclear reactions, such as result from neutron exposure.

Ion. A charged atom or molecularly bound group of atoms; sometimes also a free electron or other charged subatomic particle. An *ion pair* consists of a positive ion and a negative ion (usually an *electron*) having charges of the same magnitude and formed from a neutral atom or molecule by the action of radiation.

Ionization. Any process by which a neutral atom or molecule loses or gains electrons, thereby acquiring a net charge; the process of producing ions.

Isodose chart (radiobiology). Chart showing the distribution of radiation in a medium by means of lines or surfaces drawn through points receiving equal doses. Isodose charts have been determined for beams of x-rays traversing the body, for radium applicators used for intracavitary or interstitial therapy, and for working areas where x-rays of radioactive isotopes are employed.

Isotope. One of several nuclides having the same number of protons in their nuclei, hence belonging to the same element, but differing in the number of neutrons and therefore in mass number A, or in energy content (isomers). For example, ${}_6C^{12}$, ${}_6C^{13}$, and ${}_6C^{14}$ are isotopes. Small quantitative differences in chemical properties exist between isotopes.

Labeled compound. A compound containing radioactive atoms. By observations of radioactivity or isotopic composition this compound or its fragments may be followed through physical, chemical, or biological processes.

LD_{50} or MLD, Median lethal dose. Dose of radiation required to kill, within a specified time period, 50% of the individuals in a large group of animals or organisms.

Material inventory (reactor engineering). The quantities present of different materials—in particular, of fissionable and fertile materials. The term may represent the inventory of materials present in a reactor, in a processing or reprocessing plant, or in the entire series of establishments.

Metal inventory. Same as **Material inventory**, referring specifically to metals and, in particular, to fissionable and fertile materials.

Moderator. Material used in a nuclear reactor to moderate, i.e., slow down, neutrons from the high energies at which they are released. Some practical materials are carbon (used in the form of graphite), beryllium and its compounds, and water.

Monitoring (radiobiology). Periodic or continuous determination of the amount of ionizing radiation or radioactive contamination present in an occupied region, or in a person, as a safety measure for purposes of health protection. *Area monitoring:* Routine monitoring of the level of radiation or of radioactive contamination of any particular area, building, room, or equipment. Usage in some laboratories or operations distinguishes between routine monitoring and survey activities. *Personnel monitoring:* Monitoring any part of an individual, his breath, or excretions, or any part of his clothing. (See also **Protection survey.**)

MPC. Maximum permissible concentration. That amount of radioactive material which can be tolerated in the environment or in the body without the production of significant injury.

MPL. Maximum permissible level or limit. That amount of radiation exposure which the body can accept within a specified period without significant injury.

NCRP. National Committee on Radiation Protection.

Neutron. A nuclear particle of 0 charge and mass number 1. Neutrons produce no detectable primary ionization in their passage through matter, but ionization is produced by products of neutron col-

lisions (recoil nuclei, γ-rays from inelastic scattering and from neutron capture).

Nuclide. A species of atom characterized by the constitution of its nucleus. The nuclear constitution is specified by the number of protons (Z), number of neutrons (N), and energy content; or, alternately, by the atomic number (Z), mass number (A) [=N+Z], and atomic mass.

Parent or radioactive precursor. A radionuclide that upon disintegration yields a specified nuclide, the *daughter*, either directly or as a later member of a *radioactive series*. Thus U^{238} is the parent of all members of the uranium series, including the end-product, Pb^{206}.

Phantom (radiology). A volume of material behaving in essentially the same manner as tissue, with respect to the radiation in question, used to simulate a portion of the human body, and into which ionization chambers can be placed. Measurements made in a phantom permit the determination of the radiation dose delivered to the skin and points within the body. Materials commonly used for x-rays are water, Masonite (unit density), and beeswax.

Photon. A *quantum of* electromagnetic radiation.

Pile. A nuclear reactor. The term pile comes from the first nuclear reactor, which was made by piling up graphite blocks and pieces of uranium and uranium oxide. The term reactor is becoming more commonly used.

Poison. Material of high-absorption cross section that absorbs neutrons unproductively and reduces the reactivity of a reactor.

Power breeder. A nuclear reactor designed to produce both useful power and fuel.

Protection (radiology). Provisions designed to reduce exposure of personnel to radiation. For external radiation, this consists in the use of protective barriers of radiation-absorbing material, in ensuring adequate distance from radiation sources, in reducing exposure time, or in combinations of these. For internal sources, it involves measures to restrict inhalation, ingestion, or other modes of entry of radioactive materials into the body.

Protection survey. Evaluation of the radiation hazards incidental to the production, use, or existence of radioactive materials or other sources of radiation under a specific set of conditions. Such evaluation customarily includes a physical survey of the disposition of materials and equipment, measurements or estimates of the levels of radiation that may be involved, and a sufficient knowledge of processes using or affecting these materials to predict hazards resulting from expected or possible changes in materials or equipment.

Rad. One hundred ergs of absorbed energy per gram of absorbing material.

Radioactive half-life. The time in which the amount of a particular radioactive isotope is reduced to half of its initial value.

Radiochemistry. The aspects of chemistry connected with radionuclides and their properties, with the behavior of minute quantities of radioactive materials by means of their radioactivity, and with the use of radionuclides in the study of chemical problems.

Radiography. The making of shadow images on photographic emulsion by the action of ionizing radiation. The image is the result of the differential absorption of the radiation in its passage through the object being radiographed.

Relative biological effectiveness of radiation or RBE (radiobiology). The inverse ratio of tissue doses of two different types of radiation that produce a particular biologic effect under otherwise identical conditions. In general, the RBE may vary with the kind and degree of biological effect considered, the duration of the exposure, and other factors.

Residual activity. Radioactivity remaining in a substance or system at a specified time after a period of decay. In a nuclear reactor, the activity that remains when the reactor has been operated and then shut down.

Roentgen or r. The quantity of x- or gamma radiation such that the associated corpuscular emission per 0.001293 gm of air produces, in air, ions carrying 1 esu of electricity of either sign.

Roentgen equivalent, man, or rem. The dose of any ionizing radiation that will produce the same biological effect as that produced by 1 r of high-voltage x-radiation.

Roentgen equivalent, physical, or rep. A unit proposed to apply to statements of dose of ionizing radiation not covered by the definition of the roentgen. It has been variously defined as the dose which produces energy absorption of 83 ergs per gram of tissue or 93 ergs per gram of tissue. The actual energy absorption in tissue per roentgen is a function of the tissue composition and of the wavelength of the radiation, and ranges between 60 and 100 ergs per gram.

Scaler or scaling circuit. A device that produces an output pulse whenever a prescribed number of input pulses have been received. The number of input pulses per output pulse of a scaling circuit is termed the scaling factor. A *binary scaler* is a scaler whose scaling factor is 2. A *decade scaler* is a scaler whose scaling factor is 10.

Scattering. The change in direction of a particle or photon due to a collision with another particle or a system. (Reactor theory) Specifically, a collision of a neutron with a nucleus, such that after the collision the neutron and nucleus still exist as separate entities.

Scintillation. A flash of light produced in a phosphor by an ionizing event.

Scintillation counter. The combination of phosphor, photomultiplier tube, and associated circuits for counting scintillations.

Scintillation spectrometer. A scintillation counter adapted to the study of energy distributions.

Scram. Sudden shutting down of a nuclear reactor, usually by dropping of safety rods. This may be arranged to occur automatically at a predetermined neutron flux or under other dangerous conditions, the reaching of which causes the monitors and associated equipment to generate a scram signal. To shut down a reactor by causing a scram.

Shut-down procedure. Sequence of operations used for shutting down a nuclear reactor. It includes reducing the effective multiplication constant to less than unity by insertion of safety rods or the equivalent and, usually, reducing the flow of coolant to the amount required for removing the heat of residual activity.

Specific activity. The *activity* of a radioisotope of an element per unit weight of element present in the sample.

Start-up procedure. Specific procedure for bringing a given nuclear reactor into operation at a desired power level. This may include establishing flow of coolant, starting reaction in the counter range, increasing reaction in the counter range, increasing control, and leveling off at the reaction rate into the instrument range, approaching criticality and shifting from manual to automatic required power.

Survey instrument (radiation). A portable instrument, used for detecting and measuring radiation under varied physical conditions. The term covers a wide range of devices utilizing most of the detection methods defined elsewhere.

Tracer, isotopic. The isotope or non-natural mixture of isotopes of an element which may be incorporated into a sample to make possible observation of the course of that element, alone or in combination, through a chemical, biological, or physical process. The observations may be made by measurement of radioactivity (in the case of radioactive tracer) or of isotopic abundance, e.g., by mass spectrographic or density measurement.

Tracer studies. A technique for studying the role of an element, a group of elements, or a compound in a biological, chemical, or physical process. In this technique an isotopic tracer is employed to follow the course of the bulk material through the process. Either stable or radioactive isotopes can be used, in any desirable chemical form, but in case of radioactive tracers the amount must be so small that the radiation will not interfere with the natural course of the process under study.

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References

1. Robinson, R. C. V., quoted in AMA News, December 29, 1958.

2. Atomic Energy Commission: Twenty-third Semiannual Report, Washington, D.C., U. S. Government Printing Office, January, 1958.

3. American Standard Glossary of Terms in Nuclear Science and Technology, ASA N1.1-1957 UDC001.4:539, Edited by National Academy of Sciences-National Research Council, New York, American Society of Mechanical Engineers, 1957.

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Occupational Skin Problems

II. METHODS OF EVALUATION FOR CUTANEOUS HAZARDS

Raymond R. Suskind, M.D., Cincinnati

This is the second of a series of 12 chapters treating various aspects of occupational dermatoses. The next installment will appear in the April, 1959, issue.

WHEN the natural defenses of the skin are overcome by inciting agents in the environment, damage to the cutaneous tissues may be inevitable. Of singular importance in the prevention and control of pathological reactions to occupational environment is the knowledge of the specific effects of the environment on the susceptible tissues. The avoidance and elimination of either potential or extant hazards depend primarily upon the recognition and understanding of the disease-producing factors in the environment. Just how is such knowledge developed?

For an appreciation of etiologic factors and their physiologic effects, both immediate and remote, we must rely heavily on research and survey methods. Since the large majority of occupational dermatoses arise from exposure to injurious chemical substances, we shall concern ourselves in this review only with such hazards.

When plans are being made to produce or use a new substance in industry or to introduce a new material into consumer goods, that is the time to be concerned about its possible damaging effect on the human organism. If this is a material which is likely to come into contact with the employees' or consumers' skin, several questions must be considered:

1. Will it be absorbed percutaneously and cause systemic intoxication under usage conditions?

2. Will it be harmful to the human skin under usage conditions?

Developing information concerning toxicity, percutaneous or otherwise, is usually regarded as the work of a toxicology research laboratory. In a thoroughgoing preventive program, however, one must consider all the harmful effects of a new material, and the cutaneous appraisal may be just one segment of the toxicological evaluation. The percutaneous absorption of a toxic material may, or may not, damage the skin clinically. For example, the absorption of certain concentrations of tetraethyl lead will cause severe lead intoxication without essentially injuring the skin. There are substances which may damage the skin as well as cause systemic intoxication, e.g., chlorinated hydrocarbon solvents and phenol, and finally there are many substances which may provoke cutaneous reactions alone without systemic damage.

Fig. 1—(Left): Will skin contact cause systemic intoxication? (Right): Will it damage human skin under usage conditions?

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A new industrial material may be appraised prior to use for a variety of possible cutaneous effects: (1) primary irritation, (2) sensitization, (3) photodynamic action, (4) acnegenicity, (5) carcinogenicity, and many other possible effects, including depigmentation, hyperpigmentation, follicular inflammation, and damage to hair.

Attempts have been made to devise and standardize techniques for the detection and quantitative estimation of such hazardous effects. We shall review briefly some of the methods which may be effectively employed.

Primary Irritation and Sensitization

Since the majority of industrial skin complaints arise out of exposure to irritants and sensitizers, the appraisal of a new substance for cutaneous hazard is often limited to these two potential effects unless the molecular configuration of the compound, its physical or chemical characteristics, or previous clinical experience suggest other possibilities. Hence a chlorinated phenol, naphthalene, or diphenyl structure would suggest potential acnegenicity. Certain hydroquinone compounds may suggest possible inhibition of melanin formation or depigmentation. Petroleum oil or coal tar fractions with characteristic physical and chemical properties or compounds of certain polycyclic aromatic structure may suggest carcinogenic activity.

Tests for Irritancy

We can begin with screening the material for its ability to irritate animal skin by applying it in various concentrations to intact as well as abraded rabbit skin according to methods described by Draize et al.[1] The material may be further tested by instilling it into the rabbit eye to detect injury to mucous surfaces. If the results of the screening procedure in rabbits indicate that the material may be tested on human skin, the primary irritant effect may be studied on humans in separate tests or in conjunction with the procedure for allergenicity, as in the repetitive patch test. In any case the initial human test is frequently a pilot study in which serial dilutions of the test material are applied to the skin of a few human subjects for from a few minutes to several days, in order to determine, if possible, the threshold concentration and duration of exposure which will provoke irritation. If the usage concentration appears to be at or below this threshold, it is then important to determine the incidence of irritation reactions in a suitable population sample, e.g., 100 to 200 subjects.

Guinea Pig Appraisal

On the basis of the classical animal experiments of Landsteiner and Jacobs,[2] Draize et al.[1] have devised a method of evaluation in which repeated standard doses of the compound are administered intracutaneously to guinea pigs every other day for 10 doses; after a rest period of two weeks, a challenging or test dose is again administered intracutaneously. Determination of sensitization is made by comparing the reactions observed following the test dose to those observed during the sensitization period. A strong sensitizer, such as p-nitrosodimethylaniline, is used as the reference sensitizing material or positive control. If the values of the test or challenging dose readings are appreciably higher than for the average of the 10 original readings, the compound can be said to have produced sensitization.

There are numerous shortcomings to this appraisal technique which are somewhat obvious: (1) guinea pig strains, unless inbred for the purpose, are not uniformly susceptible; (2) for some chemical substances, the guinea pig is less sensitizable than man; (3) guinea pig skin is anatomically and physiologically different from that of man and it is not possible to directly apply the results obtained via guinea pig tests to human experience; and (4) since the threshold sensitizing and provoking concentrations of different chemical compounds may vary widely, the uniformity of the recommended schedule precludes the detection of many sensitizers. Nevertheless, for materials about which there is little knowledge regarding biological effect, this method has some value. It will detect potent eczematogenic sensitizers, and may be employed to screen such substances and avoid their being used in human testing.[3]

Human Exposure Tests

1. *Repetitive Patch Test of Schwartz and Peck*—Although there are several procedures for evaluating the allergenicity of new materials on human skin, all of them are based on essentially the same principle: human subjects are first exposed to the test material in an attempt to sensitize the skin. After a suitable "incubation period," the subjects are challenged with the same material. The most widely used test of this type in the United States is the so-called "prophetic" patch test procedure first described by Schwartz and Peck.[4] It consists of two series of patch applications, each performed 10 to 14 days apart on an adequate sampling of human subjects. Reactions noted after the initial application are considered evidence of primary irritation or previous incidental sensitization. Reactions in the second

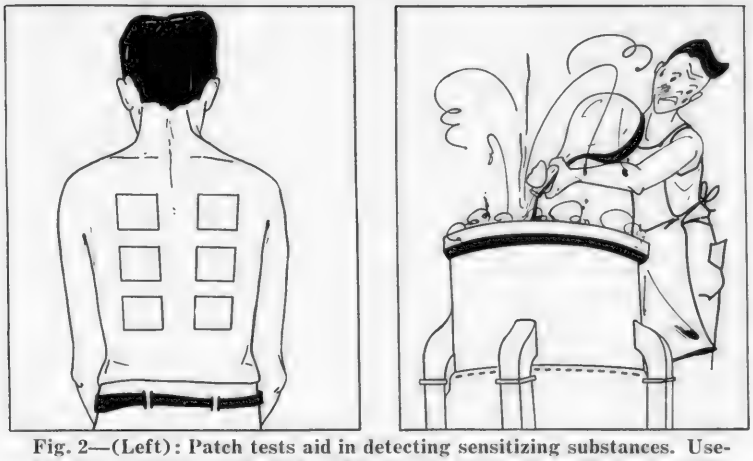

Fig. 2—(Left): Patch tests aid in detecting sensitizing substances. Usefulness of results is limited. (Right): Usage test provides most valuable information.

series alone are considered evidence of sensitization due to the initial patch exposure.

In planning the repetitive patch evaluation, an attempt should be made to approximate usage conditions as closely as possible. Some limitations of the patch test are: (1) a test site may be relatively small by comparison to the more extensive area exposed in usage; (2) single patch exposures for 24 to 48 hours may be insufficient to induce sensitization which may be readily produced by continuous daily usage exposures over many weeks or months; and (3) the results of the test may be influenced greatly by such factors as pressure of the applied material, sweating, hydration of the skin, local ventilation, and ambient temperature and humidity.

The amount of useful information which may be obtained from a repetitive patch evaluation depends upon how closely the test conditions resemble the industrial or usage exposure.

The work of Henderson and Riley[5] clearly demonstrates the need for an adequate number of subjects in any test group of this kind if statistically valid and useful information about the irritant and sensitizing capacity of a substance is to be evolved. From their findings one would be reluctant to pronounce a substance innocuous on the basis of no reactions in 100 subjects. There would be a 95% likelihood that the frequency of reactions in the general population will not exceed 3%. If the sample is 200 subjects, it is just as likely that the reaction rate might be as great as 1.5%.

2. *Other Useful Repetitive Patch Procedures*—Useful variants of this procedure have been described by Brunner and Smiljanic[6] and Draize.[7] The former may screen materials somewhat more rapidly than the prophetic patch test. Both employ a repeated exposure schedule in the sensitization period. They utilize fewer subjects, and are capable of detecting sensitizing sugstances which have a lower threshold of sensitivity than that which can be detected by the Schwartz test. They will also detect substances which will not irritate the skin following one or two exposures but only after frequently repeated contact.

It is important to realize that in utilizing a repetitive procedure, the mode and schedule of application will vary in accordance with the material to be appraised. In testing hairwave components, Brunner and Smiljanic applied a series of mercaptans in use concentrations for 30 minutes daily (corresponding to the normal period of contact in permanent waving), for five days to different areas of forearm skin. A period of one week of nonexposure was allowed to elapse, after which the applications were begun again and continued until reactions developed or until a total of three weeks had elapsed. Primary irritants were revealed by reactions which commenced during the first five days. Sensitizers were revealed by reactions which began during the retest period.[6]

In the method described by Draize, repeated applications of the test material are made every day for a total of 10 applications, followed by a rest period of 10 to 14 days. The challenging application is then made and the material removed within 24 hours. A comparison of the reactions during the 10 sensitizing doses with the reactions following the challenging dose permits an estimation of the degree of sensitization.[7]

The repetitive patch test should be used only as an aid in detecting sensitizing substances among potential industrial and consumer materials, and as a means of determining whether or not a new material should be submitted for a controlled usage appraisal.[3] It does *not* provide the final answer regarding sensitization potentials in any given usage exposure.

3. *Usage Tests*—The test which provides the most valid kind of information insofar as potential irritation and allergenicity is concerned is the usage test. When a substance has been shown to evoke a few or no reactions by the repetitive patch technique in a human test group which is statistically adequate, the final determination as to whether or not it can be used safely in industry is by a small scale trial.

During the trial usage period the workers in the test group must be observed periodically for untoward reactions. If reactions during the usage trial are negligible over a prolonged period, the material may be marketed for general use.

Cutaneous Photosensitization

Contact with materials which have photodynamic or photosensitizing properties is not uncommon in industrial processes and construction work (coal tar and petroleum distillates, pitch, essential oils, dyes, etc.). It often is technically impossible to employ nonhazardous substitutes, and therefore hygienic techniques must be used to prevent prolonged contact as well as the deleterious effects of actinic irradiation. However, when substances are to have widespread consumer distribution, such as solvents of aerosol insecticide bombs or lipstick dyes, an appraisal for photodynamic activity is essential. If such materials enhance the effect of sunlight, substitutes must be found.

It is important first to determine the action spectrum of the suspected photosensitizer. This may be accomplished by exposing human skin pretreated with the test material, through a sequence of short wave cutoff filters. In this manner increasing amounts of the short wave light region, from 2,800 to 5,000 Å may be progressively removed. In most instances photosensitizing activity for coal and petroleum fractions, dyes, and essential oils occurs in the range 3,200 to 3,600 Å. The maximum activity for many petroleum solvents is in the range 3,300 to 3,400 Å.

A method which we have used to appraise petroleum solvents is a modification of the technique described by Dunn and Brackett.[8] The solvent being appraised and the control substance, an inactive solvent, are applied on saturated gauze squares to circumscribed areas of uniform size on each forearm. The test and control sites of one forearm are then exposed to bright sunlight for a period up to one hour. The test and control sites of the opposite forearm are covered, so that they are protected from the sun. The reactions at the sites exposed and protected from the sun are observed at the end of the exposure, and periodically, for

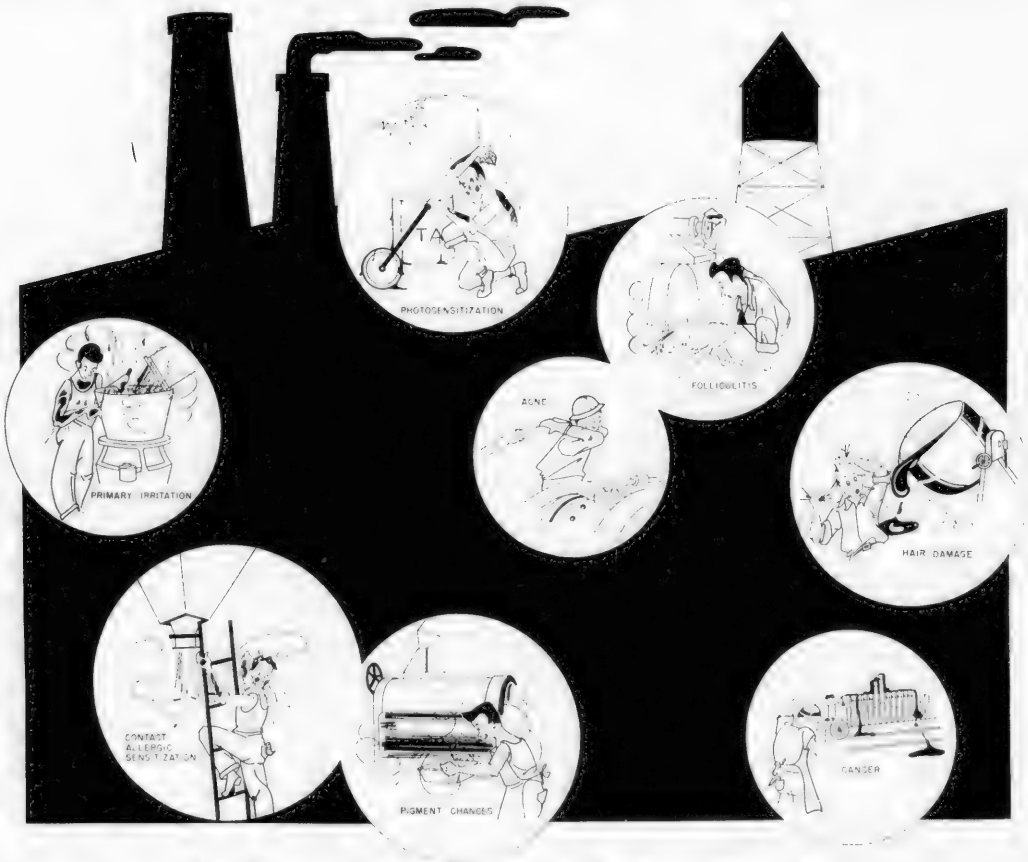

Fig. 3—Studies may be conducted for many cutaneous hazards.

48 hours. An increase in erythema and notable hyperpigmentation in the test sites exposed to sunlight as compared with the similarly treated covered sites indicates photodynamic activity. The potent photosensitizers are easily recognized, since subjects may complain after 5 to 10 minutes of pricking and burning sensation and erythema appears quickly.

Acnegenicity

The activity of materials known to be acnegenic to man has been studied by us in a large variety of experimental animals and in human subjects. The animals have included rabbits, mice, rats, dogs, cats, and guinea pigs. We have not been able to produce pilosebaceous changes equivalent or comparable to human chloracne in these animals by local application, inhalation, or ingestion of the known acnegen. The notable exception is the rabbit external ear canal area,[9, 10] which is impractical as a test site.

Acne lesions may be induced in human skin by the repeated local application of such acnegenic substances as penta- and hexachloronaphthalenes.[11–13] Since many chlorinated hydrocarbon acnegens are also hepatotoxic, any test employing human subjects must be done with great care.

A method which we have effectively employed consists of the repeated daily application of weighed amounts of nonirritating concentrations of the test material to an area of uniform size of one forearm for a period of six weeks. The positive control material which is applied similarly to another group of subjects is the known potent acnegen Halowax 1014, a mixture of hexa- and pentachloronaphthalene. Five subjects are employed in each test. The appraisal of the suspected material is afforded by a comparison of the clinical and histopathologic reactions provoked by the test substance with those induced by the control acnegen Halowax 1014. Physical examinations, hepatic function tests, and biopsies of the treated sites are performed prior to and periodically during the exposure as well as during a 12-week period following the completion of the test. No systemic effects have been observed from the application of such materials being appraised, or from the chlorinated hydrocarbon acnegens, since we have initiated this technique.

Carcinogenicity

A discussion of techniques for the appraisal of cutaneous hazards would be incomplete without mentioning measurement of carcinogenic potency. It will be hardly appropriate for this review to discuss in detail the relative merits of the many bioassay techniques or the significance of correlated examination of chemical and physical properties of complex mixtures such as petroleum oils. An assay of the biological properties of a suspected carcinogen should include the time-honored procedure of repeated application (usually two to three times each week) of the test material(s) to the skin of a susceptible strain of mice unless prior chemical examination reveals the presence of known carcinogens, such as benzo(a)pyrene. A parallel test on a positive control is particularly important in this type of bioassay to be sure that the conditions used are appropriate for the induction of tumors by a known carcinogen, preferably related structurally to the components of the complex material in question.[14] The test material should be appraised in at least two appreciably different dose levels, at the same time avoiding levels so high that serious interference with the normal growth of the mice results.

Important variables which are likely to interfere measurably with the test are incidental systemic intoxication and intercurrent infection, both of which are capable of delaying the tumor induction. It has also been demonstrated that in any given mixture containing potential carcinogens, certain noncarcinogenic organic components, particularly those having long chain structures, may act as accelerators[15] and cause the rate of induction of tumors to be much higher for a given concentration of carcinogen than would otherwise be expected. Two such potent accelerators are n-dodecane and dodecylbenzene. Therefore, the medium in which the carcinogen is found is of utmost importance.

An industrial material may, on examination, be found to contain just trace concentrations of a carcinogen which would be expected to require a full life span of repeated exposure to produce tumors. If the major components of the medium are long chain accelerators, however, this rate of tumor induction might be increased as much as fourfold and the tumors would therefore be produced in one-fourth the life span of the exposed subject.

Since exposure to accelerators either prior to or subsequent to an independent exposure to polycyclic carcinogens may also speed the time of appearance of tumors, it may be desirable to test various long chain industrial materials for this accelerating property per se. It is suggested that such accelerators played a significant role in the induction of cutaneous cancer among the mule spinners in the Lancashire cotton industry and wax pressmen in some oil refineries.[15]

Other Cutaneous Effects

Appraisal methods for determining other possible cutaneous effects of chemical hazards, such as depigmentation, hyperpigmentation, follicular inflammation and hair damage, may be set up as the need arises.

The Evaluation of Materials in an Effective Hygienic Program

If the appraisal indicates that a material is a substantial hazard, it may be discarded in favor of an innocuous material. If it cannot, for technical or economic reasons, be eliminated, a hygienic program must be devised to prevent or limit human exposure. The effective hygienic techniques which may be employed in a control program will be discussed in a later chapter.

The numerous cutaneous problems which have appeared in this age of chemistry serve to remind us of the many man-made hazards to which the skin is exposed. The real answer to such problems is found not in therapeutic but in preventive dermatology. The evaluation of materials for potential hazard is the starting point in any effective hygienic program.

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References

1. Draize, J. H.; Woodard, G., and Calvery, H. O.: Methods for the Study of Irritation and Toxicity of Substances Applied Topically to the Skin and Mucous Membranes. *J. Pharmacol. & Exper. Therap.* 82:377-390, 1944.

2. Landsteiner, K., and Jacobs, J.: Studies on the Sensitization of Animals with Simple Chemical Compounds, *J. Exper. Med.* 61:643-656, 1935.

3. Suskind, R. R.: Allergic Problems in Modern Industry, *Ann. Allergy* 10:745-754, 1952.

4. Schwartz, L., and Peck, S. M.: The Patch Test in Contact Dermatitis, *Pub. Health Rep.* 59:546-557, 1944.

5. Henderson, C. R., and Riley, E. C.: Certain Statistical Considerations in Patch Testing, *J. Invest. Dermat.* 6:227-230, 1945.

6. Brunner, M. J., and Smiljanic, A.: Procedure for Evaluating Skin-Sensitizing Power of New Materials, *A.M.A. Arch. Dermat. & Syph.* 66:703-705, 1952.

7. Draize, J. H.: Dermal Toxicity, *Food, Drug & Cosmetic Law J.* 10:722-732, 1952.

8. Dunn, J. E., and Brackett, F. S.: Photosensitizing Properties of Some Petroleum Solvents, *Indust. Med.* 17:303-308, 1948.

9. Hambrick, G. W., Jr.: The Effect of Substituted Naphthalenes on the Pilosebaceous Apparatus of Rabbit and Man, *J. Invest. Dermat.* 28:89-103, 1957.

10. Hambrick, G. W., Jr., and Blank, H.: A Microanatomical Study of the Response of the Pilosebaceous Apparatus of the Rabbit's Ear Canal, *J. Invest. Dermat.* 26:185-200, 1956.

11. Suskind, R. R.: A Study of Industrial Acnegens, read in the symposium on Industrial Dermatoses, American Academy of Dermatology and Syphilology, December, 1954.

12. Braun, W.: Chlorakne, Aulendorff, Wurttemberg, 1955.

13. Shelley, W. B., and Kligman, A. M.: The Experimental Production of Acne by Penta- and Hexachloronaphthalenes, *A.M.A. Arch. Dermat.* 75:689-695, 1957.

14. Horton, A. W., and Denman, D. T.: Carcinogenesis of the Skin: I. A Re-Examination of Methods for the Quantitative Measurement of the Potencies of Complex Materials, *Cancer Res.* 15:701-9, 1955.

15. Horton, A. W.; Denman, D. T., and Trosset, R. P.: Carcinogenesis of the Skin: II. The Accelerating Properties of Aliphatic and Related Hydrocarbons, *Cancer Res.* 17:758-766, 1957.

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Editorials

The American Academy of Occupational Medicine

In 1946, a small group of far-seeing leaders in the field of occupational medicine gathered to organize the American Academy of Occupational Medicine. It might be asked why another society in this field seemed necessary. It was believed that an organization of full-time industrial practitioners could focus attention on two troubled areas: (1) the issues that present themselves to the physician entering industry and finding a community problem on his hands, and (2) the advancement of training for younger men who wished to practice full time in industry.

The first annual meeting of the Academy, held in January, 1949, was entirely devoted to a discussion of educational facilities extant, and projected educational needs. At that time, immediate goals set forth were (1) basic agreement on curricula in the schools, (2) establishment of suitable working agreements between industry and the teaching centers, and (3) the recruitment of graduate students. These objectives were supplemented with an extensive consideration of continuing education for the beginning and established practitioner.

It appeared to the Academy that, as a preface to the attainment of these goals, definitions of the objectives, scope, and methods of occupational medicine could do much to bring into focus the many facets of practice which had evolved during the course of years. These activities had developed through an age when industrial physicians were a little less than welcome in the professional body of medicine to an era of acceptance and increasing demand for well-trained men. With due regard to the conscientious service rendered industry by many of those not engaged in full-time practice, it seemed clear to the founders that practitioners who had committed themselves to a full-time career in industry would be among those best qualified to develop professional standards and qualifications. Consequently, as one of the first orders of business, a committee of experienced charter members outlined those qualifications, standards of professional performance, and working facilities which would preserve accepted features and advance developing concepts. It seemed likely that a united professional voice would be effective in guiding development in this burgeoning area of practice.

Three agencies were at this time actively in pursuit of the objective of specialty status for occupational medicine: The Council on Industrial Health of the American Medical Association, the Industrial Medical Association, and the Academy. Under the leadership of the late Dr. Carl A. Peterson, of the Council, the three groups in 1951 jointly created an interim board. Dr. Robert A. Kehoe, the Academy's representative on this board, was named its president, and successfully directed the endeavors which in 1955 led to the establishment of occupational medicine as a specialty under the American Board of Preventive Medicine. Formal courses of graduate training had in the meantime become available at nine American universities, and the first fully trained specialists were entering industry.

With basic issues resolved, the Academy has been able to concentrate on the equally fundamental matters of continuing education for its members, Fellows, and others interested in advancing their knowledge. To this end a series of home study courses, combined with annual seminars under university auspices, has been established. These have been well received and found useful by candidates preparing for certification examinations. Thesis and certification requirements for advancement to Fellow status have provided a salutary challenge for self-improvement and give substance to the continuing effort to elevate and preserve standards. To that end, the American Board of Preventive Medicine has called on the Academy to define

the standards for in-plant residencies and to participate in examination procedures for certification.

The Academy meeting is held annually in February, this year in Boston. Listed in the membership are physicians from representative industries of the United States and Canada. Most are also members or Fellows of the Industrial Medical Association. The scientific proceedings are published in the A.M.A. *Archives of Industrial Health,* since 1957 the official organ of the Academy. Prior to that, the Proceedings were published independently in an annual volume. From time to time, the Academy Award is made to an outstanding industrial physician. The annual Gehrmann Lecture, delivered by an accomplished scholar, industrialist, or public figure, honors Dr. George H. Gehrmann, the first President, a dedicated pioneer, and very active emeritus Fellow.

We extend to the Academy our congratulations on these productive years. The atomic space age to be ushered in during the next decade will present us all with new problems that resemble the old ones only in that they appear at first sight to be insoluble. We derive comfort from the fact that your organization exists at this crucial time.

Report of the Larson Commission

A contemporary American philosopher holds that agreement upon issues is not a requirement in a free society of educated men; that the mark of this status rests, rather, upon a capacity to understand conflicting viewpoints and to perceive the reasons for disagreement.

The American Medical Association has just released a report of a commission's work that qualifies well as an effort to understand the many sides of many complicated questions. Made public on January 17, the Report of the Commission on Medical Care Plans, Part I, inevitably destined to be called after the name of the committee's chairman, the Larson Commission Report, may be expected to have a profound effect upon the formal relations between organized medicine and the nonphysician agencies that play a role in the provision of medical care.

As is regrettably the case with many basic documents that ought to be read completely in the original, this report will come to the minds of many busy physicians in fragments and summaries prepared by commentators. It will be possible, by quoting out of context, to adduce support from the original for many sides of many arguments. Mindful of this pitfall, this journal will next month present a lengthy abstract that will seek to acquaint the reader fairly and honestly with its essential contents.

The report reviews four methods of providing medical care by formally administered plans: miscellaneous and unclassified (by managements, unions, fraternal orders, and variously organized physicians), medical society approved plans (Blue Shield and private insurance programs), industry programs, and student health services. Most industrial physicians will be amazed to find that their special field of practice was a part of this study.

A list of generalizations is presented about occupational health programs, "based on a 7% return of questionnaires mailed to almost 3,000 members of the Industrial Medical Association." A response rate as low as this tends to throw some doubt about the representativeness of the data collected in the study. Perhaps there were qualitative aspects, such as the chance inclusion of a high proportion of opinion-formers and policy-makers among the respondents, sufficient to compensate for the apparent quantitative defects.

The first section of the report, on the other hand, presents a study of miscellaneous and unclassified plans which is truly impressive. As a result of 27 visits to 19 plans in 10 cities, the commission developed a first-hand acquaintance with the personnel and facilities of the plans under study and then met with representatives of local medical organizations to discuss what had been observed and to learn the views and experiences of community practitioners with respect to the plans. The impression was gained that physicians who are employed in such plans like this form of practice. The commission was satisfied that as regards one plan at least 90% of the patients covered were highly pleased with the medical care they received. The feelings of physicians in private practice toward such plans vary from one city to another.

The section contains an interesting chapter on free choice of physician. It is pointed out that ultimately no patient has this choice, and Section 5 of the Principles of Medical Ethics is quoted: " . . . 'a physician may choose whom he will serve' . . . in which case the patient may be denied his choice"; and recognition is paid to the indirect denial of free choice inherent in the staffing of hospitals on the basis of specialty certification and other considerations in the interests of quality care imposed by the physicians themselves.

All in all, this document supplies much light to an area that previously received much heat. Its appearance is a timely, fortunate, and happy event.

Industrial Medical Association

THE PRESIDENT'S MESSAGE

H. W. LAWRENCE, M.D.

I HOPE you read your first issue of this Journal with the same pride and joy we experienced in bringing it to you. At this point, there is no question in our minds that we are definitely in the publishing business for years to come, and that our Journal is destined to contribute significantly to the progress of occupational medicine. Our initially predicted circulation of 4,000 for the first issue was exceeded, and new subscriptions are coming in. Although gratified with this fine beginning, let us remind ourselves that no journal starts out with an established reputation—this can only be earned and developed over many months and years of successful operation. A great deal of our future effectiveness and success will depend upon the active help and participation of our members. We should seek to publish in our Journal the most important trends and research activities pertaining to occupational medicine. We want this Journal to rank high as your own personal source of help with occupational health problems. In order to accomplish this, our editorial staff can be helpful in serving as a proper clearing house of our membership experience through free communication. Our editor assures us that he will strive for a wide variety of technical papers, addresses, news and editorials covering every possible facet of our field. Speaking of editorials, I direct your attention to the excellent one appearing in this issue pertaining to the American Academy of Occupational Medicine. This editorial emphasizes the fact that the Journal's scope of interest will not be limited exclusively to IMA affairs. We will all be generously exposed to the objectives, programs, and accomplishments of other groups and organizations having an interest in occupational health. Our constant appraisal of these activities can only accrue to our mutual benefit.

We also intend our Journal to be a financial success. This can be accomplished only through the sale of advertising. Advertising is not included merely to relieve the monotony of the printed page. Advertising supports the Journal, and incidentally, the advertiser as well. It is our business to convince the advertiser that his sales promotion dollar is well spent in our Journal. We can do this quite effectively and honestly because we represent the tremendous buying power of 4,000 key individuals in industry. Even though we may not be direct purchasers, we certainly specify our needs, we suggest, we select, we requisition. In other words, we shop for the items most suitable to our purpose. All this buying potential, however, is of no help to the Journal unless we can make the advertiser aware of the fact that seeing it in the pages of our own Journal influences our purchases. We can let our advertisers know that their ads are being read by making inquiries about the product and by mentioning the Journal. It is important to let our advertisers know that you are interested in their products. It is neither sinful nor unethical to ask our current suppliers to consider our Journal as a proper advertising medium for their products. In other words, our interest in our advertisers makes it possible to support a better journal. With the short time that has been available to us, we have made a modest but solid start in this direction. Progress in this phase of publishing will become more evident to you with every successive issue. We fully expect to end up on the right side of the ledger when we balance our books at the end of the year.

Book Reviews

ATOMIC POWER, by the Editors of Scientific American. Price, not given. Pp. 178. New York, Simon & Schuster, 1955.

The field of atomic energy may still be regarded by some physicians as a highly technical and difficult area for casual study. "Atomic Power," a collection of articles which originally appeared in the monthly magazine, *Scientific American*, should refute at least part of this contention. Although the atomic energy industry is indeed exceedingly complicated when examined in detail, the broad principles can be presented in an interesting and understandable manner.

The explanation of the principles involved in the "breeding" or manufacture of new fuel in an atomic reactor is a good example. According to Dr. Robert A. Charpie, of the Oak Ridge National Laboratory, breeded reactors were a main focus of interest at the first Geneva Conference, in 1955. Countries poor in uranium, thorium, and fossil fuels, look to this principle as a possible ultimate solution to their energy resources problem. A pound of uranium is equivalent to approximately two and a half million pounds of coal; hence the cost of transporting atomic fuel is negligible. The use of nuclear fuel would tend to equalize the cost of fuel throughout the world.

In the experimental breeder reactor (EBR-1) at Arco, Idaho, the original charge of fissionable fuel is a football-sized piece of uranium^{235} which is loosely surrounded by a honeycombed "blanket" of natural uranium^{238}. When the U^{235} fissions, an average of 2.5 neutrons is released. One of these has to be eventually captured by another U^{235} nucleus in order to keep the chain reaction going. This leaves one or more "spare" neutrons available to bombard the natural U^{238} in the blanket. When the nucleus of the U^{238} atom captures one of these neutrons, it becomes U^{239}, which decays soon after to plutonium^{239}. Some of this plutonium also fissions, yielding several neutrons which help maintain the chain reaction and also help convert more U^{238} to Pu^{239}.

The number of plutonium atoms manufactured is greater than the number destroyed, and as time goes on, the total amount of fissionable material, or fuel, is actually increased. The new fuel generated in the blanket can be removed by chemical processing and eventually put back in place of the original fuel charge, U^{235}. Thus, a country could buy a small amount of expensive U^{235} and much more of the less expensive natural uranium and then manufacture its own plutonium. While this "breeding" is going on, the reactor is producing tremendous amounts of heat which can be transferred by liquid sodium in a heat exchanger to produce steam for a turbine generator.

Although this sounds like the ideal way to produce economical electricity from atomic power, there are many problems yet to be solved. The engineering difficulties associated with breeder reactors are "enormous." Neutron losses in and from the reactor have to be reduced to an extremely low level. Unfortunately, the engineering requirements for a power reactor actually tend to increase the loss of neutrons. The chemical processing required to recover the new fuel bred in the blanket is difficult and expensive. Since the breeding principle is established, the ultimate success of breeder reactors will depend on solving the chemical processing problems.

It is now generally believed that breeder reactors will not be the first to produce competitive electricity from atomic power. A more conservative type of reactor, such as a boiling water, a pressurized water, or possibly even a gas-cooled graphite reactor, will come first.

This book is divided into six major sections, each of which is discussed by several outstanding experts. The first section, "Power Reactors," is a review of the development of reactors from the first Chicago pile to the design of the latest type reactors. "Resources," is a discussion of the world uranium supply, and "Fuel and Fission Products" describes what is being done to reprocess fuel elements to remove nuclear poisons. "Economics and Politics," examines the important problem of the price per kilowatt hour of atomic power and reviews the Atomic Energy Act of 1954. The section on "Radiobiology" may seem disappointingly short to physicians, but, of course, this material was not written primarily for them.

Although this book was copyrighted in 1955, the sections on the basic principles of fission reactors will be valuable for a long time. However, the last major section, "Thermonuclear Reactions," clearly demonstrates the momentum of the atomic energy program. Dr. Louis Ridenour in his chapter "The Hydrogen Bomb I" says, "While fission can be controlled in an orderly way to produce useful power in a reactor, the fusion reaction offers no prospect at the present time of any use except in terms of an explosion." Only three years later, the Geneva Conference of 1958 was principally devoted to the problems of harnessing thermonuclear power for peace time use and significant progress was reported!

THOMAS A. LINCOLN, M.D.

ENGINEERING CONTROL OF HEALTH AND SAFETY HAZARDS IN URANIUM MINES. James Westfield, R. H. Flinn, A. D. Look, and G. G. Morgis. Bureau of Mines Information Circular 7834. Price not given. Pp. 20. United States Department of the Interior, 1958.

This article reviews the occupational hazards associated with uranium mining and some of the engineering problems involved in the control of these hazards. These are, in approximate order of importance, radiation hazard primarily from radon daughters, the dangers of silicosis from exposure to free silica dust, toxic injury following the ab-

sorption of uranium and vanadium compounds, and the danger from underground accidents of the type occurring in mining operations. The bulletin reviews the field method for sampling and determination of concentrations of radon daughter products worked out by the U. S. Public Health Service and presents it in a straightforward and usable form.

The discussion of the ventilation requirements for control of radioactivity and for control of dusts outlines some of the major considerations which come into play and influence the type of control measures. The authors point out that, since radioactivity from radon and its daughters is the primary health hazard, the ventilation must be somewhat different from that used to control the dust or silicosis hazard. Unlike dust, the radon concentrations tend to increase during the time that the mine is inactive and build up to concentrations many times the currently accepted allowable concentrations. Personnel working at the face can be protected from the radioactive dusts and gases by relatively small volumes of air supplied close to the working area. This is in direct opposition to the usual industrial hygiene control ventilation, where the attempt is made to remove the contaminant at its source rather than to dilute it with fresh uncontaminated air. The authors point out that air from other parts of the mine is not fresh in the sense that it might not be free from the radioactive gas radon or its daughters. The discussion of ventilation for control of dust is sketchy. In fact, the only specific control method mentioned is use of water and hygroscopic agents to prevent the dispersion of dust into the atmosphere. Mention of the combined radiation and silica hazard of dust in uranium mines is made, but no measurements are presented to indicate the dust concentrations likely to be encountered. Where single shift operations are carried on, it is suggested that blasting be done only at the end of the shift with an overnight period for settling of dust and clearing of the atmosphere.

The need for safety training and supervision is indicated and many additional hazards are briefly mentioned. The responsibilities of the Federal Bureau of Mines and the state regulatory agencies are reviewed. The authors emphasize that the Federal Bureau of Mines has no authority to enter a non-coal-mine without the consent of the operator unless the mine is on government-owned or government-controlled property. Suggestions for correcting hazards noted by the inspector are made in the form of recommendations only and do not have the force of law. Review of the examples of state regulatory measures pertinent to uranium mining make clear that enforcement of such codes will be difficult. The inspection of all such mines at the intervals suggested constitutes a problem in logistics. Since a good portion of the mines in question consist of small operations, with fewer than five men working underground, most of them will have no facilities for the health and safety services which might be available in a larger mining company. The article concludes with a list of recommendations designed to insure the health and welfare of those involved in uranium mining.

This is a timely article calling attention to some of the major health and safety hazards of uranium mining and describing a field method for evaluating the primary hazard. Anyone responsible for control of this type of health hazard should certainly consult some of the excellent references listed on the last three pages.

NOTE: The reviewer is indebted to Dr. Charles Lewis for his comments based on his first hand observation of uranium mining.

EDWARD C. RILEY, M.D.

THE FOURTH ANNUAL SEMINAR FOR INDUSTRIAL PHYSICIANS

"MAINTAINING EMOTIONAL HEALTH"

will be presented by

THE MENNINGER FOUNDATION

Topeka, Kansas, March 2-6, 1959

The seminar is for occupational physicians who are concerned with the health maintenance of a major segment of a company. The sessions will treat major areas: psychodynamics, or basic theory of psychological motivation; principles of psychiatric examination; and psychiatric treatment. Lectures will be followed by demonstrations and discussions. For further information, write Harry Levinson, Ph.D., Director, Division of Industrial Mental Health, The Menninger Foundation, Topeka, Kansas.

Abstracts of Current Literature

Industrial Hygiene

Edward C. Riley, M.D.

Developing an Ordinance and Code for Food Vending Machines. W. C. Miller. Pub. Health Rep. 73: 903 (Oct.) 1958.

Miller reviews the history of vending machines and the tremendous increase in both number of machines and variety of food dispensed in such machines in the past few years. He discusses the model ordinance prepared by the U. S. Public Health Service in 1957 under title of "The Vending of Food and Beverages; A Sanitation Ordinance and Code; 1957 Recommendations of the Public Health Service (PHS Pub. 546, Washington, D.C., U. S. Government Printing Office, 1957). It goes almost without saying that supervision of this type of health hazard in industry will fall to the medical department and, in many incidences, the industrial hygiene laboratory to advise management of the health hazards involved.

Syringe Device for Studies on Bacterial and Other Aerosols. C. E. Brown.* A.M.A. Arch. Indust. Health 18:415 (Nov.) 1958. (*U.S.A. Chemical Corps, Fort Detrick, Frederick, Md.)

"A small device with which a single operator may obtain information on aerosols under various atmospheric and other conditions was developed mainly for studies on survival of air-borne bacteria, but may be used also for other aerosols." Although the specialized techniques used for studying bacterial aerosols are somewhat removed from those generally familiar to the industrial hygienists, the understanding of aerosols is basic to the understanding of physiologic responses to aerosols whether they be dusts, mists, or bacterial aerosols. The technique for diluting and sampling aerosols in a compact apparatus may well be applicable to other types of particulate dispersions in much the same way as the air blender is used for solvent vapor air mixtures.

Chronic Chloroform Intoxication. P. J. R. Challen, D. E. Hickish, and J. Bedford. Brit. J. Indust. Med. 15:243, 1958.

This report of an "environmental and clinical investigation of 8 employees with an average length of exposure of 5.4 years to an industrial exposure to chloroform presents an unusual opportunity to verify the permissible concentrations or the MAC." Those long-service employees who were exposed to concentrations ranging from 77 to 237 ppm complained of severe symptoms, but no evidence of liver damage was found in those who submitted themselves to medical examination and liver function tests. "In another group of 10 employees exposed to concentrations ranging from 22 to 71 ppm, 8 complained of less severe symptoms." The authors consider the maximum allowable concentration of 100 ppm, recommended by the American Conference of Governmental Industrial Hygiene, too high. The evidence of the present investigation "supports the value of 50 ppm suggested by the Imperial Chemical Industries Limited."

An Investigation of Some Health Hazards in an Inert-Gas Tungsten Arc Welding Shop. P. J. R. Challen, D. E. Hickish, and J. Bedford. Brit. J. Indust. Med. 15:276, 1958.

This study of aluminum welding utilizing inert gas-shielded tungsten rods attempts to evaluate the effect of the welding in relation to the adjacent degreasing operations. Measurements of ozone, trichloroethylene vapor, and phosgene were carried out. In spite of the fact that measurable concentrations of trichloroethylene were found in the welding shop, the most significant exposure proved to be ozone, with concentrations from 0.8 to 1.7 ppm. "Eleven out of fourteen employees complained of upper respiratory symptoms."

The trichloroethylene degreaser was responsible for vapor exposures between 84 and 466 ppm in the degreasing shop. The authors recommended exhaust ventilation for the degreasing shop "with the dual purpose of reducing the exposure of the operator, and to insure that the direction of air flow is from the welding shop to the degreasing shop and not vice versa."

Although no symptoms were reported after concentrations of ozone were reduced to about 0.2 ppm, the authors feel that the American Conference of Governmental Industrial Hygienists[1] MAC of 0.1 ppm is a wiser control level than the former 1.0 ppm level.

"A system of local exhaust ventilation which did not remove the inert-gas shield . . . is described and the effectiveness of the system is demonstrated by substantial reductions in the concentrations of ozone in the workshop."

Glass Microspheres as Inhalation Tracers. V. A. Gordieyeff.* A.M.A. Arch. Indust. Health 18:389 (Nov.) 1958. (*Died April 30, 1958.)

The author presents a technique for studying the penetration, retention, and distribution of inhaled solid particles in the respiratory system. While this is in the nature of a preliminary report, since the results were obtained from a fairly wide distribution of particle sizes and the concentrations of aerosol were not uniform throughout the exposure, it is obvious that the study represents the result of a tremendous amount of work to develop highly specialized techniques.

The findings indicate that particles as large as 3.0-4.0 microns were occasionally found in rabbit alveolae. "The smaller bronchi contained frequently particles as large as 6.0μ 7.0μ, while the

main bronchi and the trachea carried quite often particles in the 9.0μ-12.0μ range of diameters." Studies of the glass spheres recovered from respiratory organs of rats exposed to aerosol clouds indicated that between 40% and 95% of the particles retained were smaller than 1μ. The mass diameter of the aerosol was about 1.5μ and the concentration of the aerosol about 150 to 175 mg/m^3. The exposure time for the eight rats was six hours.

This technique provides a new approach to the study of the physical and physiologic properties of inorganic dusts in the size ranges that are frequently found in industrial operations involving crushing and grinding. The introduction of the cobalt glass spheres, permitting a sensitive spectroscopic check of the analytical results, will greatly increase confidence in the qualitative and quantitative results.

Evaluation of Chemical Cyanosis Through Improved Techniques for Hemoglobin Analysis. E. E. Evans,* R. C. Charsha, and A. L. Linch. A.M.A. Arch. Indust. Health 18:422 (Nov.) 1958. (*Med. Div., Indust. Hyg. Lab., Chambers Works, E. I. du Pont de Nemours & Co., Inc., Penns Grove, Pa.)

The potential exposures of personnel to aromatic amino and nitro compounds in the chemical and dye industry makes the correct interpretation of laboratory blood studies important to the industrial physician. The relationship between the methemoglobin and cyanosis has long been recognized, but this study investigates the basis of latent cyanosis and suggests how this may be determined from a 0.1 ml blood sample from the ear lobe. The determination of methemoglobin precursors in the blood after exposure to cyanosis-producing chemicals is based on the difference in concentration between acid hematin values and oxidized hemoglobin concentrations. Normally there is good agreement between the two values; when there is a significant difference, it is presumed to be caused by hemoglobin complexes of aromatic nitro and amino compounds or their metabolites. These tests have been carried out over a two year period during which 35-75 specimens per week were analyzed for routine control purposes.

"A comparison of hemoglobin values determined by oxidized hemoglobin and acid hematin procedures in the same blood specimen provided an estimation of hemoglobin complexes which may be methemoglobin precursors."

"No one method of hemoglobin analysis is sufficient for cyanosis control."

Note: The industrial hygiene control is difficult in situations where the chemicals can be readily absorbed through the skin. Since most of the operations are carried out in closed reactors, there is little exposure except when there is failure of the equipment or during routine maintenance operations. In these situations, air samples are seldom helpful and clinical examination and laboratory analysis may give the first indication of overexposure.

Abstracts

Hand and Automatic Degreaser Operations. Michigan Occup. Health Bull.* Vol. 3, No. 4, Summer, 1958. (*Copies are available from the Division of Occupational Health, Lansing, Mich.)

Trichloroethylene degreasers are used throughout industry for many purposes and in many sizes. In many cases the safe operation of trichloroethylene degreasers has been taken for granted without consideration of all the possibilities of industrial hazards. This article lists 35 potential problems which should be considered and includes diagrams and sketches relative to the operation and ventilation, where required. Paragraph 34 which reads as follows: "Degreasers should not be located in the vicinity of arc welding units, particularly units which are inert-gas shielded.

"The ultra-violet light emitted by the arc can convert relatively small concentrations of trichloroethylene or perchloroethylene into hydrochloric acid and phosgene. Because vapors from degreasing solvents can travel long distances, it may be necessary to provide mechanical ventilation at the degreaser to prevent highly toxic phosgene from forming *in the welding area.*"

Anyone planning a new installation or in charge of an existing installation should read this bulletin and make sure that degreaser operators are properly instructed before the unit is placed in operation.

Dermatology

Donald J. Birmingham, M.D.

Sporotrichosis as an Occupational Disease Editorial. Indust. Med. & Surg. 27:167 (March) 1958.

Sporotrichosis is not usually considered to be associated with an occupation etiology. However, in South Africa in 1943, such an epidemic occurred. The disease affected 2,825 gold miners before it was brought under control. Through detailed epidemiologic investigation, the disease was found to be definitely associated with occupational exposures. The fungus Sporotrichum schencki was traced to mine timbers. It was cultured on appropriate media and later identified as being indistinguishable from the organism which had been isolated from the lesions. After chemical treatment of the mine timbers to eliminate the presence of the fungus organisms, the epidemic was brought under control.

Diseases of the Nails: 792 Cases; Clinical and Microscopical Findings with Resume of Newer Therapeutic Methods. C. J. White* and T. C. Laipply. Indust. Med. & Surg. 27:325 (July) 1958. (*Department of Dermatology, Stritch School of Medicine of Loyola University, Chicago)

Dermatologic aspects of diseases of the nails can be classified under infectious disease, localizations of various dermatoses, and traumatisms. Occupational exposures can be associated with changes ranging from simple stains to marked

destruction of the nails resulting from contact with a variety of chemicals handled in modern industry. Oils, tars, and greases may cause characteristic brownish or blackish discoloration of the nail. Secondary infection occurs in numerous cases of occupational dermatitis. The deformities caused by trauma are common among workmen.

NOTE: Among workmen, almost all disorders of the nails are generally attributed to one's occupation. The necessity of being able to exclude non-occupational infectious disease or localization of endogenous disease is important.

Traumatic Calcinosis of the Skin. I. B. Sneddon* and R. McL. Archibald. Brit. J. Dermat. 70:211 (June) 1958. (*Rupert Hallam Department of Dermatology, Sheffield, England)

Calcification of traumatized skin sites in two coal miners is described. The men were working at the mine face where highly mineralized water was dripping from the roof and leaving crystalline deposits on the roof.

At the sites of injury, both miners had fine, white, firm papules. One of the men showed linear lesions. Histologic section in one of these cases showed calcium deposits. Both cases displayed similar histologic patterns. The mine water contained 3.5 calcium chloride, 1% magnesium chloride, and 10% sodium chloride. This water was applied to the skin during scarification, and the lesions were reproduced in one of the men. However, the histologic section of the reproduced lesions failed to reveal calcium deposits. The article also included other examples of calcium deposits from contact with calcium chloride, which causes necrosis as well as foreign body reactions.

Plastic Planing in Chloracne. W. R. Hubler.* A.M.A. Arch. Dermat. 77:111 (Jan.) 1958. (*1510 S. Brownlee, Corpus Christi, Texas)

Eight patients with chloracne caused by Unichrome wax used in chrome electroplating were treated by the author. Antibiotics, x-ray therapy, and the usual local acne modalities failed to improve the disease. After six months of local treatment, three patients were treated by plastic planing. The planing technique removed the top of the residual lesions. After which the eruptions underwent complete resolution. The five remaining patients, continued on local therapy, have failed to improve.

NOTE: Plastic planing of chloracne lesions has produced far more rapid results than local treatment methods, but this rewarding therapy will be short-lived unless contact with the offending agent is absolutely eliminated.

Dermatitis in Industry. D. C. Braun* and R. Sitgreaves. A.M.A. Arch. Indust. Health 17:259 (April) 1958. (*Industrial Hygiene Foundation, 4400 Fifth Ave., Pittsburgh 13)

The incidence and causes of occupational dermatitis were determined by a six months' prospective survey of 36 companies employing 103,586 persons located in five geographical areas and representing eight industrial categories. The cooperating plants furnished the data through report forms. Personal visits to each plant furnished information about the plant, the number of employees, types of exposure, and existing medical facilities.

The annual rate for occupational dermatitis was 0.8 per hundred. Of the 436 cases of occupational skin disease reported, 40% were attributed to petroleum products. Cutting oils accounted for 69% of all dermatoses due to petroleum products. There was a slightly higher incidence among females generally, but among production workers the rate for females was twice that for males.

Internal Medicine

Shermer H. Stradley, Jr., M.D.

Pleuritis in Systemic Lupus Erythematosus: Its Importance as an Early Manifestation in Diagnosis. W. A. Winslow,* Ann. Int. Med. 29:70 (July) 1958. (*Division of Pulmonary Diseases, Montefiore Hospital, New York.)

Systemic lupus erythematosus should be considered in the differential diagnosis whenever pleuritis appears as an isolated finding or in combination with arthralgia, arthritis, or other symptoms suggesting a collagen disease. The diagnosis of lupus is sometimes difficult, especially since the recognition of the false-positive L.E. phenomenon occurring with drug reactions in tuberculosis, hepatitis, and diabetes, and in cases of rheumatoid arthritis, given large doses of steroids over long periods. Even skin and muscle biopsy may be confusing.

The pleuritis of systemic lupus apparently is episodic, usually clearing rapidly and completely. Pleuritis usually causes dramatic pain, and when x-ray changes are added, in the absence of pneumonitis, the diagnosis is narrowed. The prompt study of idiopathic pleuritis for lupus as well as for tuberculosis or neoplasm becomes increasingly urgent in view of the favorable therapeutic results with steroid therapy.

Acute Pericarditis After Smallpox Vaccination. V. F. Cangemi.* New England J. Med. 258:1257 (June 19) 1958. (*Jersey City Medical Center. Jersey City, N.J.)

Cangemi points out that the serous surfaces of the body are sensitive to a variety of noxious agents. Pericarditis occurs rather frequently in rheumatic fever, uremia, and bacterial infections. Despite the extensive use of smallpox vaccination throughout the world, comparatively few complications occur. The instance of pericarditis reported here following smallpox vaccination suggests an anaphylactic reaction. The time lag from the time of vaccination to the onset of symptoms supports the theory of an antibody-antigen response. Were the pericarditis due to

direct virus invasion, one would have expected the onset of symptoms to follow vaccination sooner.

This case of pericarditis and reports of pericarditis following tetanus antitoxin inoculation suggest that the pericardium may be affected by an antibody-antigen reaction and acute pericarditis result.

Absence of previous reports of similar reactions makes coincidence a more likely explanation.

Biochemical Concepts of Schizophrenia. J. R. Smythies.* Lancet 2:308 (Aug. 9) 1958. (*Galesburg State Research Hospital, Galesburg, Ill.)

Psychological theory holds that the warping of a child's psychological development is sufficient explanation for the development of adult schizophrenia. The schizophrenic is withdrawn because early environment forced the child to withdraw, and no specific metabolic fault is involved. Smythies refers to studies relating to the hypothesis that there is faulty metabolism of one or several substances. The possible roles of adrenalin, taraxein, and lysergic acid diethylamide, (a powerful hallucinogen) and the relation of its possible effects on serotonin are discussed, as is another theory, implicating the metabolism of acetylcholine in the brain.

Based on facts currently at his disposal, the author concludes that schizophrenia is a genetically determined disorder of the metabolism of the neurohumors of the central nervous system: noradrenalin, adrenalin, serotonin, and/or acetylcholine. The concept of a faulty adrenalin metabolism and its relation to stressful situations causing a vicious circle, as perhaps being the key-factor in schizophrenia, is summarized.

The conclusion is reached that there are sufficient facts to show that purely psychogenic theories can no longer be held as total explanations of the cause of schizophrenia.

Cardiac Disease and Hypothyroidism: Complications Induced by Initial Thyroid Therapy. E. E. Wallach, G. D. Lubash, B. D. Cohen, and A. L. Rubin.* J.A.M.A. 167:1921 (Aug. 11) 1958. (*Cardio-Renal Laboratory, Second [Cornell] Medical Division, Bellevue Hospital, New York.)

Attention is called to the fact that sometimes replacement therapy in hypothyroid patients, instead of reversing the disease, may cause cardiac complications such as myocardial failure, angina pectoris, myocardial infarction, and even dissecting aneurysm, especially in the older age groups showing evidence of arteriosclerosis such as calcification of the aortic knob and cardiac enlargement. Four of nine patients developed cardiac complications early in the course of therapy. These complications appeared to be related to initial vigorous treatment rather than to total dosage. Too energetic early treatment of hypothyroid patients in the older age group may increase the metabolic demands and cause an enlarged heart to function above its capacity. It is suggested that for such patients therapy be begun with 7.5 mg. of desiccated thyroid per day, with increments of 7.5 mg. every two to three weeks until a daily dose of 30 mg. is reached. Larger increments may then be used with care until the desired euthyroid state is attained. The slightest indication of any cardiac complication demands immediate reduction of dosage.

International Symposium on Sarcoidosis. Lancet 2:261 (Aug. 9).

It is pointed out that the histologic changes can only be reported by the pathologist as being consistent with sarcoidosis since sarcoid tissue is a nonspecific response to a variety of agents. Chemical, infective, and neoplastic processes are known to provoke local sarcoid tissue reactions.

The value of the oral cortisone test to differentiate the hypercalcemia of sarcoid from that of parathyroid tumor is emphasized. Orally administered cortisone increases the fecal excretion of calcium, and the serum calcium level falls to normal in sarcoidosis. The serum calcium elevation occurring with parathyroid tumor is unchanged by cortisone.

The most important indications for corticosteroid therapy are (1) stressing eye disease, (2) disfiguring skin lesions, (3) hypercalcemia, and (4) a worsening chest radiograph.

Triamcinolone is proving as effective as prednisolone, and a new drug by Squibb, SQ9727, shows equal promise.

Mental Health

Graham C. Taylor, M.D.

Labor's Viewpoint of Alcoholism in Industry. Leo Perlis.* Indust. Med. & Surg. 27:535 (Oct.) 1958. (*9 E. 40th St., New York City)

Perlis, who is the director of AFL-CIO Community Service Activities, states that alcoholism is a problem both to management and to labor. The Community Service Activities of the AFL-CIO are conducting a survey of the labor movement to clarify labor's attitude toward this problem and to see in what way labor and management may cooperate in setting up a program for alcoholics. With some notable exceptions, such as Allis-Chalmers, Boeing Aircraft, Bell Telephone Laboratories, the New York Times, and a few others, there is a lack of planned programs, by either management or labor, to attack this problem.

Alcoholism in Industry. P. S. Morgan.* Indust. Med. & Surg. 27:458 (Sept.) 1958. (*Industrial Relations Manager, Morgan Construction Company, Worcester, Mass.)

Morgan states that alcoholism ranks third in prevalence among major health threats, with only mental and heart ailments ranking higher, and that $432,000,000 a year in wages are lost due to absenteeism caused by excessive drinking.

There is outlined how one company tackled the problem successfully which should be of interest

since most companies are not doing very much about this issue.

The program involves a careful study by the employment manager in a company of 5,000 to determine which employees are alcoholics and therefore need help. This help may include referral to Alcoholics Anonymous, to a local hospital's Alcoholic Clinic, to a psychiatrist. Of equal importance is careful counselling with the employee.

It also involves close collaboration with the Industrial Physician and an education program with the line organization.

A New Approach to Executive Appraisal. W. V. Machaver, and W. E. Erickson. Personnel, July/August 1958, pp. 8-14.

The industrial physician may be called upon to give an opinion concerning executives, and in this article the authors explain how executives are appraised in one company. The use of a personnel specialist is favored; he interviews the superior who analyzes the subordinate's work in a systematic fashion. "Although the interviewer probes and questions, the executive still makes the final decisions concerning the appraisal." Hence, the specialist does not take over executive authority. The specialist prepares a résumé of his findings, which is reviewed by the superior. The crucial step is the superior's discussion with his subordinate, and for this the executives of the U.S. Reduction Company were given some preparation for the counselling processes by role-playing.

Standard Earning Progression Curves: A Technique for Examining Individual Progress in Work. E. Jaques. Human Relations 11:167, 1958.

This work represents a continuation of the author's studies described in "Measurement of Responsibility" (Harvard University Press, 1956). He considers that there exist norms of differential payment for various levels of work, and when payment is in accord with these norms there is a recognition that it is fair and equitable. The employee seems to have an intuitive knowledge of these scales.

"A person's primary drive with respect to his work is towards a level of work that can absorb his capacities; towards a job in which he can use his capacities to the full. His drive for money follows from this prime urge to employ his skill and talent in his work—and is a drive for a rate of reward that is equitable and gives him a relative economic status coinciding with his capacity. The notion that individuals strive in the first place to get all the money they can is, in my experience, a seriously oversimplified and unnecessarily nihilistic account of human behaviour."

Jaques concludes that "(a) each person seeks a level of work that is consistent with his level of capacity, and a rate of progress in his work that conforms to his rate of development in capacity; (b) individuals have an accurate intuitive judgment of their capacity and rate of growth in capacity, although for reasons of physical or psychological ill health, or lack of opportunity, they may not always be able to gain employment in which they can exercise their capacity to the full; (c) each person is intuitively aware of and seeks the current equitable rate of payment for his level of work; (d) there is a common pattern of feelings which characterized the reactions of individuals to deviations between their level of work and their capacity."

Noise and Hearing

H. O. Parrack, Ph.D.

1954 Wisconsin State Fair Hearing Survey—Statistical Treatment of Clinical and Audiometric Data. A. Glorig, D. Wheeler, R. Quiggle, and Anne Summerfield. Research Center, Subcommittee on Noise and Industry, American Academy of Ophthalmology and Otolaryngology, Los Angeles, 1957.

The results of the analysis of data obtained on 3,500 persons attending the 1954 Wisconsin State Fair are contained in this report. Data in the report pertain to the decrease of hearing ability with increasing age, differences between the auditory thresholds of males and females, differences between the auditory thresholds of right and left ears, differences between the auditory thresholds of urban and rural groups, and data on the evaluation of normal hearing. In addition, an analysis has been made of the effects of noise on hearing loss as evidenced by the auditory thresholds of office, farm, and factory workers. The hearing loss of persons working in industrial noise receives special treatment, as do the auditory effects of exposure to the noise from gunfire, and the auditory thresholds of men with military service. The data given are essential to an understanding of the relations between occupational noise exposure and man's hearing.

Guide for Conservation of Hearing in Noise. H. P. House* and Committee. Subcommittee on Noise in Industry, Committee on Conservation of Hearing. Am. Acad. Ophth. & Otolaryng. 1957. (*Research Center, 111 N. Bonnie Brae St., Los Angeles 26)

This simple language statement on conserving hearing in noise contains two major sections: The first furnishes general information, and the second technical information, about hearing conservation programs. The general section gives basic information about hearing loss and noise exposure, indications of the need for a hearing conservation program, the components of a hearing conservation program, and responsibility for conservation of hearing. The second section contains technical information on the assessment of noise exposure, the control of noise exposure, and the measurement of hearing.

Methods for Conservation of Hearing. H. P. House.* A.M.A. Arch. Indust. Health 16:445-448, (Dec.) 1957. (*1136 W. 16th St., Los Angeles 17)

This short paper provides general guidance on

how to determine wnen a requirement for hearing conservation exists. It outlines the steps that should be taken to establish an appropriate hearing conservation program and briefly describes some of the instruments that are available for use in conducting such a program.

A New Concept in Auditory Screening. A. Glorig* and H. P. House. A.M.A. Arch. Otolaryng. 66:228 (Aug.) 1957. (*111 N. Bonnie Brae St., Los Angeles 26)

The measurement of hearing is an important part of a hearing conservation program. In industry, a major problem arises as to means for measuring the hearing of a large number of personnel in a short time. This paper describes this problem and several approaches to its solution. In particular, it describes a recently developed single-frequency screening test that is relatively easy to use and requires a minimum of time when it can be applied. Data are given to establish the validity of this method when compared with more elaborate clinical audiometric methods.

Is There a Suitable Industrial Test of Susceptibility to Noise-Induced Hearing Loss? A. Summerfield,* A. Glorig, and D. E. Wheeler. Noise Control 4:40 (Jan.) 1958. (*111 N. Bonnie Brae St., Los Angeles 26)

There have been many attempts to devise a test to determine susceptibility of an industrial worker to noise-induced hearing loss. This paper describes seven tests that have been proposed, evaluates their use, and indicates whether they have actually been applied in industrial situations. The authors conclude that none of the susceptibility tests discussed have been validated and express the opinion that none of the proposed tests are suitable, even for field trial. In an appendix, the authors indicate the factors that must be studied in validating any method of testing susceptibility to noise-induced hearing loss.

What is Zero Hearing Loss? H. Davis* and J. R. Usher. J. Speech & Hearing Disorders 22:662 (Dec.) 1957. (*818 S. Kingshighway, St. Louis 10)

To compare data that describe the hearing losses caused by exposures to industrial noises, it is essential that the instruments used for measuring hearing be based upon the same standard for normal hearing. The present American standard for normal hearing for audiometric purposes is defined in the "American Standard for Audiometers for General Diagnostic Purposes" (American Standards Association, Standard Z24.5-1951). The accuracy and adequacy of this standard have frequently been questioned, particularly, since the publication of recent British data on normal hearing, which diverge significantly from those upon which the American standard is based. This paper reports on a group evaluation of the various factors which led to the differences between the British and the American standard and which have given rise to the criticism of the American standard. The paper is important for those responsible for conducting audiometric tests as a part of the hearing conservation program because it clearly sets forth the various uncertainties about the current standards for normal hearing.

What Constitutes Disability and How is it Measured? H. Davis,* A.M.A. Arch. Indust. Health 16: 454 (Dec.) 1957. (*818 S. Kingshighway, St. Louis 10)

One of the most vexing problems facing practitioners of occupational medicine is the determination of the extent of hearing disability. The author discusses many facets of this complex problem and suggests a middle ground position, that the important aspect of hearing is the ability to understand speech under everyday conditions. This is true because speech is the most important thing to which we listen, since it makes a difference to us in practical ways on the job and off the job. Because of this fact, it is recommended that hearing disability resulting from noise exposure be evaluated in terms of the extent to which it prevents understanding everyday speech under everyday living conditions.

Problems in Military Audiometry. J. R. Usher.* J. Speech & Hearing Disorders 22:729-756 (Dec.) 1957. (*818 S. Kingshighway, St. Louis 10)

Adequate audiometric measurement is an essential component of an industrial conservation of hearing program. This paper is a summary of a symposium pertaining to audiometry in a particular kind of industrial organization, the military service. However, the same problems will confront anyone setting up an audiometric program as a part of an industrial hearing conservation program. The report deals with problems such as compensation for hearing loss, diagnostic audiometry, classification of hearing tests, automatic audiometry, and limitations on audiometry. The occupational medicine specialist will find valuable guidance toward the solution of the same problems as he faces them in setting up his program to measure hearing by audiometric methods.

The Effects of Noise on Man. Karl D. Kryter. J. Speech & Hearing Dis., Monograph Supp. 1, 1950.

This article is a review of the literature published before 1950 on the effects of noise on human behavior, deafening effects of noise, and effects of noise on communication by speech. The review of the deafening effects of noise summarizes and critically reviews the published data on hearing loss resulting from noise exposure. Based on the critical review, a method is suggested for possibly predicting the effects of noise on the hearing function. This suggested method of estimating the effects of noise on the ear is important because it has been the starting point for most of the recent tentative criteria for permissible occupational noise levels, where the aim has been to avoid significant noise-induced hearing losses. The summary

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of published data about the effects of noise on voice communication is applicable to the problem of maintaining necessary person-to-person communication in noisy work areas.

Medical Care Administration

Asa Barnes, M.D.

Canada's National Hospital Insurance Program: What It Is. M. G. Taylor.* Hospitals 32:43 (Oct. 1) 1958. (*University of Toronto, Toronto, Ont. Canada.)

The hospital Insurance and Diagnostic Service Act, which went into effect on July 1, 1958, makes federal funds available to the Canadian provinces for the purpose of financing hospital care insurance. The provinces are permitted a wide range of freedom in the form and methods of administration but certain requirements are mandatory: The provinces must maintain adequate records and accounts respecting the cost of hospital services, and they must assure that high standards are maintained in hospitals through licensing and inspection services.

The federal cost-sharing formula is designed to pay half the total costs of hospital service in the nation is a whole but to meet a larger share of the expenditures in low-cost provinces than in high-cost provinces.

If a province includes outpatient benefits, the federal government will pay the same proportion of the outpatient costs as it does of the inpatient costs in that province.

Concord Out of Conflict. Editorial, J.A.M.A. 167: 2206 (Aug. 30) 1958.

The Richmond County (Georgia) Medical Society would not accept into membership six physicians who treated fee-paying patients at the University of Georgia's Talmadge Memorial Hospital while serving as faculty members of the medical school. The society argued that the physicians did not receive the fee and, therefore, were taking part in the corporate practice of medicine. The hospital contended that all fees went into a research fund and that payment of fees from patients able to pay as preferable to free service. The faculty members alleged that the Richmond County Medical Society, by keeping them out, was, in effect, denying them membership in the American Medical Association and thus jeopardizing their careers.

A committee of seven physicians appointed by the A.M.A. Board of Trustees met with representatives of the medical school, and hospital, the state medical association, and the county medical society. The outcome was an agreement which recognizes that it is not the policy of the medical school to enter into the practice of competitive medicine and permits, but does not require, that fees be deposited in a research fund of the hospital. A committee from the medical school and the medical society was created to resolve cases that might lead to controversy. The success of the A.M.A. committee can be attributed to the desire of its members to learn all the facts and their willingness to travel to the scene and examine the issues in systematic detail. Much credit must be given to the committee who determined the facts and objectively turned conflict into concord through direct negotiations with the parties concerned.

Recent Sociologic Trends in Medical Practice. W. A. Sawyer.* J.A.M.A. 161:313 (May 26) 1956. (*1001 Penfield Road, Rochester 10, N.Y.)

From the viewpoint of enlightened management and enlightened labor leadership, there seems to be little difference in health goals. The worker carrying a union card seems to be quite the same kind of human being, with the same health problems, as the one who does not. I regard these two developments, industrial medicine and union health plans as the two significant trends of the day. They are departures from private practice and as they grow in numbers and extent they demonstrate rather definitely that medical care can and is being provided in new ways.

In-plant medical care has expanded in some instances to include certain phases of out-plant care. While it canot be said that this has become a trend as yet, there is increased talk of the need for such care.

Reliable sources have estimated that in the five-year period from 1948 to 1953, the number of workers covered by health and welfare funds rose from about 2,000,000 to about 16,000,000 and the number of dollars expended from about 200,000,000 to about 1,500,000,000. The aim of the union health plan is generally the same and that is for truly comprehensive family medical care on a prepaid basis with special emphasis on prevention, through health education, early detection and treatment of medical problems, and prompt rehabilitation and return to productive work.

Experiment in Elevating Standards of Medical Care: The Coal Country Controversy. W. H. Potter. Harvard M. Alumni Bull. Vol. 32. July, 1958.

During the latter part of World War II, while the U. S. Government was operating the coal mines, an official investigation of the deplorable living and medical conditions of the people of the area gave rise to the creation of the United Mine Workers Welfare and Retirement Fund.

In the early 1950's the UMWA Welfare and Retirement Fund formed a subsidiary corporation, the Miners Memorial Hospital Association. This corporation has built 10 hospitals at a cost of about $35,000,000, providing approximately 1,000 beds. Each hospital was staffed with full-time chiefs of service certified by their respective specialty boards. They are open-staff hospitals and welcome any reputable licensed holder of an M.D. degree to staff appointment.

The hospitals have been in operation since early 1956. They have all been accredited. Two of the central hospitals have obtained approval in medicine and surgery, effective since July, 1957.

There is no question in the eyes of those who joined the MMHA that this is the way medical care should be given. This is in contrast to the feeling of some on the outside, who prefer to go it alone but are apprehensive about organized groups.

The Expansion of Fringe Benefits and Industrial Dentistry. L. G. Morvay.* Indust. Med. & Surg. 27:402 (Aug.) 1958. (*30 Central Ave., Newark, N.J.)

The general trend in fringe benefits soon may be reflected in expanding requirements for dental services. Clauses providing for various kinds of dental treatment are being included in union contracts, workmen's compensation legislation, and industrial insurance policies.

Under the new labor compensation laws of many states, the employer is responsible for repair or replacement of artificial dental appliances which are accidentally broken during working hours. Management must take the position that, since it is required to pay for medical and dental services, it has the right to provide for them directly. The plant dentist must be exclusively designated in the health insurance policy as the person to render all emergency dental service arising from employee claims.

The high cost to management of dental injuries and emergencies stems not alone from lost man-hours, but from a dangerously indifferent attitude toward industrial dentistry.

Orthopedic Surgery

Owen E. Miller, M.D.

Osteotomy of the Cervical Spine: Report of a Case of Ankylosing Spondylitis. M. R. Urist.* J. Bone & Joint Surg. 40-A:833 (July) 1958. (*Department of Surgery, University of California School of Medicine, Los Angeles)

Urist presents a method of osteotomy of the cervical spine for Ankylosing Rheumatoid Spondylitis. The C7-D1 level was chosen, as the spinal canal is relatively wide in this area and the eighth cervical nerve root has good flexibility in the area. In motor function, the eighth cervical is overlapped by the seventh cervical and the first dorsal. If damaged, it will give slight weakness of the ulnar nerve function in the hand, but still consistent with good hand function. Furthermore, the vertebral artery usually enters the transverse foramina of the cervical spine at the sixth cervical vertebra level, passing forward to the seventh. The technique consists of removing the lamina, spinous process, pedicles of the seventh cervical, and the adjacent margins of the transverse processes of the seventh cervical and eight dorsal. In addition, the spinous processes and lamina of the sixth cervical, first dorsal, and part of the second dorsal are removed. The ligamentum flavum is not removed. Following this resection of bone, the neck is gently but firmly extended, rupturing the annulus fibrosis anteriorly at the seventh cervical level. No bone grafts are placed. The wound is closed and the patient is placed in a full spinal brace equipped with a jury mast and a turnbuckle to raise the chin. During a two week period, at increments of a few millimeters daily, the extension is gradually increased watching carefully for signs of nerve injury. When correction is achieved, in two weeks a minerva jacket was applied for ten weeks. In the case reported of a forty-four year old woman with the disease involving the spine only, the woman's neck was essentially flexed to a point where her chin rested on her chest and jaw motion was difficult. By grotesque rotation, she was able to see forward. By means of the noted osteotomy with an angulation of 64 degrees at the site, apex anterior, the patient's head was placed very near to a neutral position.

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Dermal Overgrafting of the Leg. G. V. Webster,* R. A. Peterson, and H. L. Stein. J. Bone & Joint Surg. 40-4:796 (July) 1958. (*Department of Surgery, University of California School of Medicine, Los Angeles)

Loss of skin and subcutaneous tissue is associated with compound fractures, avulsions, or burns of the lower extremity. When the lost tissue is replaced by thin scar, the latter may break down from trivial trauma or from vascular imbalance, particularly if it overlays bone. In young healthy persons replacement with a pedicle graft is indicated. In older, debilitated patients this is precluded. The authors present the dermal overgraft as an alternative. The scarred area is usually abraded with Wet-or-Dry 100D grit sandpaper until a bleeding surface is encountered and then irrigated, and a 0.015 inch thick split-thickness graft applied. A pressure dressing is applied for 10 to 14 days and the leg elevated. A second or third overgraft may be applied at a later stage to achieve thickness. Ten illustrative cases are presented.

Non-Union of the Epiphysis of the Lateral Condyle of the Humerus. C. C. Jeffery.* J. Bone & Joint Surg. 40-B:396 (Aug.) 1958. (*Princess Elizabeth Orthopaedic Hospital, Exeter, England)

Fractures of the lateral condyle of the humerus with a small wedge of bone posterolateral to the metaphysis occur usually in children from the ages of 4 to 10 years. Jeffery classifies them as minor with minimal outward displacement, or major with displacement plus rotation. In this series of nonunion, 10 occurred after plaster immobilization with minor displacement and 3 after open reduction with a soft suture. The patient with nonunion usually develops displacement with secondary cubitus valgus and is susceptible to a late ulnar nerve palsy. Jeffery suggests that those with minor displace-

ment may be treated by plaster immobilization, but his cases suggest that only those with no displacement can safely be treated in this manner. For those with displacement, he advises an open reduction with screw fixation, the screw missing the epiphysis. Three cases of nonunion treated with iliac bone grafts with excellent results are reported.

Primary Bone-Forming Tumours and Their Relationship to Skeletal Growth. C. H. G. Price.* J. Bone & Joint Surg. 40-B:574 (Aug.) 1958. (*Pathology Research Laboratory, University of Bristol, Bristol, England)

A study of the two commonest bone forming tumors—osteochondroma and osteogenic sarcoma—is presented by Price. The data are derived from the British Empire Cancer Campaign Annual Report (1949); Stocks and Barrington (1925); Myerding (1927); and Geschickter and Copeland (1949). Both tumors appear more frequently in males, in the age groups to 34 and above the age of 50. Tumors of the humerus and pelvis appear more frequently in women. In both sexes the tumors of the upper arm and shoulder girdle appear at an earlier age. Both tumors appear to be related to aberration of enchondral growth in length of bone. The tumors are noted in the areas of bone growth and where bone remodeling occurs. The female skeleton matures earlier than the male and the tumors appear in general at an earlier age. The fully grown man is about 10% bigger than the female in almost all respects. The corresponding additional growth of enchondral bone during a longer growing period in boys corresponds roughly to the greater risk of tumor in the male.

Femoral Head Phlebography: A Method of Predicting Viability. A. Hulth.* J. Bone & Joint Surg. 40-A:845 (July) 1958. (*Royal Academic Hospital, Uppsala, Sweden)

Hulth demonstrates a method of determining the degree of vascular damage in intra-articular fractures of the femoral neck. The principal blood supply to the head is through the ligamentum teres and from the medial femoral circumflex artery running along the posterior side of the base of the neck and its two principal branches, the superior and inferior retinacular arteries which run in the synovial reflections at the superior and inferior edges of the neck. As the vessels are relatively small they are difficult to ascertain by angiographic technique. Hulth postulates that if their corresponding veins are intact, they will also be intact. He demonstrates the continuity of the veins by placing a cannula after reduction of the fracture into the center of the head by x-ray control. Two milliliters of 35 to 50 percent umbradil are injected in eight seconds. An antero posterior film is taken immediately, followed by a lateral. In two minutes the antero posterior is repeated. If the contrast media flows out through the fracture area, he concludes vein and artery damage and calls it a negative venogram. If one of the noted veins is seen, it is called a positive venogram. Eighty-two venograms were done with fifty-two positive, thirteen negative, and seventeen uncertain. In the patients with the negative venograms, early signs of necrosis appeared and the degree tended to be marked. Avascular necrosis appeared in ten with positive venograms, the degree being in general less than those with a negative venogram.

The Patella in Degenerative Joint Disease: A Clinicopathologic Study. R. A. Haliburton,* and C. R. Sullivan. A.M.A. Arch. Surg. 77:677 (Nov.) 1958. (*Mayo Foundation, Rochester, Minn.)

One hundred nineteen patellas from one hundred nine patients were examined and graded according to the degree of degenerative changes. The patellas were from patients having patellectomy for degenerative joint disease. The disease is commoner in women than in men. Predisposing factors were considered to be trauma, lateral dislocation of the patella, and obesity. Lateral dislocation of the patella is commoner in women and thought to be secondary to greater knee valgus associated with weakness of the vastus medialis muscle. The greater incidence of this condition in women gives women a higher incidence of degenerative joint disease of the knee. The examined patellas were graded according to the degree of disease from a grade one, with primarily a degeneration of the articular cartilage, to a grade three with an eburnation of the articular surface with marginal hyperplasia. In the series patellectomy gave subjective improvement in a high proportion of the patients, particularly those with advanced disease.

Experimental Toxicology

Robert E. Eckardt, Ph.D., M.D., and B. E. Bennison, M.D., M.P.H.

Three Cases of Acute Lead Poisoning: Analysis of Organs for Lead, and Observations on Polarographic Lead Determinations. O. Karlog* and K. O. Moller. Acta pharmacol. et toxicol. 15:8 (Sept.) 1958. (*University of Copenhagen)

A polarographic method is described for the determination of lead in body tissues. The lead content is reported for organs removed from three cases of acute lead poisoning after ingestion of lead monoxide in attempts to produce abortions. Particularly high concentrations were found in the liver (16-124 μg./gm). High lead concentrations were found in the fetus present in one of the women, the Pb concentration of the fetus liver being higher than in that of the mother. It is suggested that lead-poisoned mothers have a high chance of bearing infants who are also lead-poisoned.

Toxicity of 1,1,1-Trichloroethane as Determined on Laboratory Animals and Human Subjects. T. R. Tarkelson,* F. Oyen, D. D. McCollister, and V. K. Rowe. Am. Indust. Hyg. A. J. 19:353 (Oct.) 1958. (*Dow Chemical Co., Midland, Mich.)

One of the least toxic of the chlorinated hydrocarbons, 1,1,1-trichloroethane (methyl chloroform), has an LD_{50} of 5.6 gm/kg for rabbits and 12.9 gm/kg for rats. It causes conjunctival irritation but no corneal damage when applied to the eyes of rabbits. The toxicity from skin absorption is low: 4 gm/kg does not kill rabbits in 24 hours. It causes only reversible irritation from repeated application of 500 mg/kg. Inhalation of 500 ppm/7 hour day/6 months causes no detectable injury in rats, rabbits, guinea pigs, and female monkeys. In the most sensitive animal, the guinea pig, inhalation of 1,000 ppm for 3.0 or 1.2 hours/day and 2,000 ppm for 1.0 or 0.5 hour/day results in slight lung and liver damage. Exposure to 500 ppm for 7 hours and 1,900 ppm for 5 minutes causes no evidence of systemic injury to humans. Therefore, on the basis of animal and human experimental data, and wide experience from its use as a bucket solvent, a seven to eight hour daily exposure threshold limit of 500 ppm is suggested.

Experimental Silicosis: The Morphogenesis of a Silicotic Nodule. P. Gross,* M. L. Westrick, and J. M. McNerney. A.M.A. Arch. Indust. Health 18:374 (Nov.) 1958. (*Mellon Institute, Pittsburgh)

Early silicotic nodules arise from alveolar walls abutting the vessel and do not lie in a space between the adventitia of the vessel and the alveolar walls. The peri- and paravascular collections of very small cells, which form in the lungs of rats exposed to quartz silica dust for one to four months demonstrate a radial pattern of reticulin fibers. In addition, the absence of a peripheral delimiting reticulin membrane in many early nodules gives further evidence against the theory that silicotic nodules are formed by influx of silica-bearing phagocytic cells into perivascular spaces. Thus, a new concept is formulated. It holds that silica particles penetrate into the lung interstitium without the aid of wandering phagocytes and that silicotic nodules are initiated by the proliferation of cells within or upon the alveolar wall to form cell clusters that subsequently enlarge and become collagenized. Many excellent photo micrographs are included to support this concept.

An Experimental Study of Aerosol Deposition in Human Subjects. P. E. Morrow,* E. Mehrhof, L. J. Casarett, and D. A. Morken. A.M.A. Arch. Indust. Health 18:292 (Oct.) 1958. (*University of Rochester Atomic Energy Project, Rochester, N. Y.)

In 17 experiments on seven normal subjects seated at rest, the mean mass deposition of submicronic heterogeneous sodium chloride aerosol (count median diameter of 0.052μ) was found to be 63.4%. This is compared with the value of 40-48% predicted by the commonly accepted particle size-deposition relations. The hygroscopic nature of the salt is not believed to satisfactorily explain this high value, the actual greater deposition of particles under 0.1μ in diameter probably being as important a factor as hygroscopicity. (The predictions assume that deposition of particles below 0.1μ in diameter is about the same as for 0.1μ particles.) It was also found that as respiratory frequency increases, mass deposition appears to decrease; as mean tidal volume increases, mass deposition also increases; as *inspired* air flow rate increases, deposition increases, but as *expired* air flow rate increases, deposition decreases. There appears to be no basis for selecting any one or more of these physiologic parameters as primary factors affecting deposition. An extensive list of references to the literature on aerosols is included.

Cataracts and Ultra-High-Frequency Radiation. D. G. Cogan,* S. J. Fricker, M. Lubin, D. D. Donaldson, and H. Hardy. A.M.A. Arch. Indust. Health 18:299 (Oct.) 1958. (*Massachusetts Eye and Ear Infirmary, Boston)

Ultra-high-frequency radiation (at 468 megacycles per second) was repeatedly applied to rabbits in doses near the lethal level distributed over the whole body. (Group A: wave guide exposures of 60 milliwatts/cm^2 for 20 minutes, given weekly for 4-7 weeks; Group B: same given daily for 10 days; Group C: "free-space" exposures of 30 and 60 milliwatts/cm^2 for 90 and 15 minutes, respectively, given twice weekly for 5 weeks). No cataracts developed following the exposures. This appears to be consistent with earlier reported experiments with microwaves ($\geq$ 1000Mcps) in which the threshold dose for cataracts in rabbits was found to be 120 to 200 mw/cm^2. No attempt at further comparison is made because of the different frequencies used. The fact that the cataractogenic dose for monkeys is higher than for rabbits with local microwave irradiation is cited as support for maintaining that studies in rabbits provide an assessment of cataractogenic possibilities in human beings.

The Toxicity of Allyl Alcohol: I. Acute and Chronic Toxicity. M. K. Dunlap,* J. K. Kodama, J. S. Wellington, H. H. Anderson, and C. H. Hine. A.M.A. Arch. Indust. Health 18:303 (Oct.) 1958. (*University of California School of Medicine, San Francisco)

Allyl alcohol (CH_2=$CHCH_2OH$) is a pungent volatile liquid with adequate warning properties, being readily recognizable at a concentration of 0.78 ppm. It is an unusually severe lacrimator, with severe eye irritation occurring at 25 ppm. The oral LD_{50} is 71 mg/kg for the rabbit, 96 mg/kg for the mouse, and 99 mg/kg for the rat. By the intraperitoneal route the LD_{50} is 60 and 42 mg/kg for the mouse and rat, respectively. The percutaneous LD_{50} for the rabbit is 89 mg/kg. For a single vapor exposure of one hour, the LC_{50} for rats is 1060 ppm, for four hours it is 165 ppm, and for eight hours, 76 ppm. (true LC_{50} values are somewhat lower than this because of a reported 15 to 25% loss of alcohol vapor from the exposure chamber). On repeated vapor exposure, there was no evidence of a cumulative effect after 60 ex-

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posures of seven hours/day, five days per week to concentrations ranging from 1 to 150 ppm. No effects were observed at concentrations up to 20 ppm. Above this level, toxic effects were observed, but no fatalities occurred until concentrations reached 60 ppm. In chronic feeding studies, allyl alcohol was incorporated into the drinking water of rats for a period of 13 weeks over a concentration range of 1 to 1000 ppm. Again, there was no evidence of a cumulative toxic effect. Weight gain was not retarded until levels of 250 ppm were reached, and effects were minor, even at 1,000 ppm. In both acute and chronic studies, intoxication was manifested by lacrimation, dyspnea, apathy, and weight loss; peripheral vasodilation was noted in rabbits. The characteristic lesions were visceral congestion and periportal necrosis of the liver. The alcohol was not irritating to the rabbit skin and did not cause permanent eye damage. A threshold limit of 10 ppb is suggested on the basis of sensory studies in humans.

Lithium Studies: 1. Toxicity. M. Schou.* Acta pharmacol. et toxicol. 15:70 (Sept.) 1958. (*Aarhus University, Risskov, Denmark)

The principal toxic effect of intraperitoneally administered lithium chloride in rats appears to be on kidney function. Rats on a low sodium intake diet ($\leq$ 5 mEq/kg/day), and repeated daily injections of as much as 1 mEq lithium/kg are able to excrete all the lithium administered. The 24-hour serum lithium concentration remains relatively constant (at about 0.2-0.3 mEq/l.) with a pronounced polyuria, during which the urine is hypotonic, being the only sign of altered renal function. The effects are completely reversible. At doses of 3 mEq lithium/kg or higher, however, the 24-hour serum lithium rises continuously—moderately so during the first week, during which the effects are reversible if treatment is stopped. If treatment is continued, blood lithium rises very sharply thereafter. The effects are irreversible and death generally occurs within one to three days, once the sharp increase occurs, even if lithium treatment is stopped. At dosages of 10 mEq/kg the sharp rise in blood lithium is immediate. As lithium accumulates in the blood, there is a transition from polyuria to oliguria and azotemia develops. When the low sodium diet is supplemented with sodium chloride by daily injections of 5 mEq sodium/kg, rats tolerate doses of lithium as high as 3 mEq/kg, and is sodium is increased to 10-20 mEq/kg, up to 5 mEq/kg is tolerated and survival times at higher dosages are prolonged. Thus sodium intake will protect rats against the toxic action of lithium up to a point, beyond which renal failure will eventually occur. It is believed that polyuria is caused by direct injury at the sites of active resorption of water in the tubules. The protection offered by sodium is presumably due to competition between lithium and sodium for entrance and resorption through the tubule cells.

Lithium Studies: 2. Renal Elimination. M. Schou. Acta pharmacol. et toxicol. 15:85 (Sept.) 1958.

Renal clearances of lithium, sodium, and endogenous creatinine were determined in rats given single intraperitoneal injections of lithium chloride and sodium chloride in varying doses. The lithium/creatinine clearance ratio ranged between 0.02 and 0.77, and varied inversely with the filtered lithium load and directly with the urinary sodium excretion. It is concluded that lithium and sodium compete for resorption in the renal tubules.

Deposition of Fluoride in Soft Tissues Following Skeletal Saturation. M. J. Wagner,* G. K. Stookey, and J. C. Muhler. Proc. Soc. Exper. Biol. & Med. 99:102 (Oct.) 1958. (*Indiana University, Bloomington, Ind.)

In rats given daily doses of 1 mg F (as NaF) by stomach tube over a period of 90 days, no increase was found in the fluoride content or concentration of heart, liver, or kidney. The total fluoride content in each case was < 3 μg. There were no trends to suggest that fluoride content would increase measurably with ingestion of additional fluoride. The fluoride content of the carcass, femur, and sternum increased markedly with fluoride ingestion, but the rate of retention decreased throughout the experiment, particularly after attainment of skeletal maturity. Fluoride not retained in the skeletal tissues is apparently excreted rather than secondarily deposited in vital tissues. While the final tissue fluoride values were well within the range of controls, a decrease in weight gain in the treated vs. the control groups is offered as evidence of the toxic effect of this level of fluoride in the diet. This is equivalent to the level considered optimal for children using water from communal fluoridation sources.

A Study of the Uptake, Distribution, and Absorption Rate of Inhaled Arsenic (As^4). R. H. Holland. R. H. Wilson, D. A. Clark, and H. C. Lanz. Abstracted, J. Lab. & Clin. Med. 52:822 (Nov.) 1958.

The original paper covers pulmonary smoke distribution patterns and disappearance rates of As^{74} in eight human subjects who inhaled the smoke from a cigarette impregnated in its distal half with 250 μc of As^{74} in the form of sodium arsenite. The pulmonary disappearance rate of arsenic was uniform and extremely rapid during the first four days. Also reported in the original is the arsenic content of the mucosa from tracheobronchial trees obtained from smokers and nonsmokers.

Metabolism of Sr^{90} in Adult Beagle Dogs. B. J. Stover,* and D. R. Atherton. Proc. Soc. Exper. Biol. & Med. 99:201-205 (Oct.) 1958. (*University of Utah, Salt Lake City)

Retention and plasma concentration of Sr^{90} in six young adult beagle dogs was determined for

two years following a single intravenous injection ranging from 0.593 to 105 μc/kg. Retention (% dose) was found to follow the power function (t in days): $R = 70.9\ t^{-0.198}$. Plasma concentration (% dose/gm of plasma) follows the functions: $P_1 = 0.114\ t_1^{-0.371}$, where $t \leq 1$ day and t_1 = minutes after injection, and $P_2 = 5.03 \times 10^{-3}\ t_2^{-1.25}$, where $t \geq 1$ day and t_2 = days after injection. Comparison of these results with those from similar studies on Ra^{226} shows the anticipated similarity in metabolism of these two radioactive isotopes. Sr^{90} retention is, however, less than that of Ra^{226}, even though the latter is excreted more efficiently. This results from higher Sr^{90} plasma concentrations, which are thought to result from stronger protein complexing and greater reexchange of Sr^{90} from bone to body fluids, in addition to less efficient excretion. Since Sr^{90} deposits mainly in the skeleton and its daughter Y^{90} does not translocate, the retention equation can be used to calculate average skeletal dose rates for these dogs.

Radiation Health

Thomas S. Ely, M.D.

Radioactivity and the Human Skeleton (Janeway Lecture, 1958). L. D. Marinelli.* Am. J. Roentgenol. 80:729 (Nov.) 1958. (*Argonne National Laboratory, Lemont, Ill.)

One hundred thousand persons living in Illinois communities drink water which contains amounts of radium close to or exceeding the highest recommended permissible level for general populations. Chicago, by contrast, uses water of surface origin containing relatively little radium. Analyses of radon exhaled by members of these groups were made to estimate skeletal concentration. The findings of this study, together with the data from other similar studies, enable an empirical relationship to be drawn between water radium intake and skeletal content.

The most feared effect of radioactivity in the human skeleton is bone cancer. The maximum permissible level of radium in the skeleton was established at 0.1 μg on the basis of the least amount present in seriously injured workers among the relatively small group of New Jersey dial painters, and a safety factor of ten. With the advent of large-scale nuclear fission and some resulting bone-seeking isotopes, the matter of permissible level becomes increasingly important.

In order to refine the present level, it is necessary to obtain more data which can be used to relate the incidence of bone cancer to radiation dose. Some information is available from several groups: Radium dial painters from several areas; the Illinois populations previously mentioned; patients who have received thorium dioxide (Thorotrast) and who should have significant burdens of Ra^{226}; workers in thorium refineries; and certain populations in India and Brazil who live over thorium-containing sands, and receive an external dose which might be translated into terms of an internal radium level. The data from these populations at the present time, despite some gaps and uncertainties, may be plotted in order to compare bone cancer incidence to skeletal level of radium. The result suggests a curvilinear relationship. Efforts should continue for the location and coordinated study of populations with significant radium levels, particularly the dial painters and patients who have received thorium dioxide.

Radiation Doses in Diagnostic X-Ray Procedures. T. A. Lincoln* and E. D. Gupton. Radiology 71:208, (Aug.) 1958. (*Post Office Box X, Oak Ridge, Tenn.)

Studies to determine skin and gonadal doses in diagnostic x-ray procedures were made in two hospitals, two clinics, and three industrial installations. Measurements were made with ionization chambers placed in appropriately located receptacles in a paraffin-filled display manikin phantom. Tabulation of the results indicated that values ranged between the lowest and the highest of those given in three cited references. The principal reasons were differences in voltage, filtration, and coning. Target-to-skin distances were almost identical for all the machines, and accounted for little of the variation. Modifications in techniques, including the use of high voltage, high filtration, proper masks and cones, and fast film, resulted in substantial reduction of dosage.

A table of average doses per film was developed which allowed the estimation of gonadal doses for large groups. Such an evaluation of the employees at Oak Ridge National Laboratory yields an average yearly dose of 13.5 mrad to the testes and 35.0 mrad to the ovaries.

A sample personal radiation exposure record card and medical examination radiation exposure questionnaire are presented.

Gonadal Exposure Dose from Diagnostic X-Ray Procedures. A. Feldman,* G. C. Babcock, R. R. Lanier, and D. Morkovin. Radiology 71:197 (Aug.) 1958. (*4200 E. Ninth Ave., Denver)

Radiation measurements in patients, in cadavers, and in phantoms, were used at the University of Colorado Medical Center to estimate the gonadal dose to be expected from several routine diagnostic x-ray procedures. Two situations must be considered, the case in which the gonad is within the useful x-ray beam, where the dose is received from the primary beam plus scatter, and the case where the gonad is outside the beam, where the dose is entirely from scatter. The limitation in sensitivity of available instruments makes it difficult to measure dosage from the latter source in patients. One mechanism by which this limitation can be circumvented is the use of one dosimeter in a series of patients undergoing the same procedure.

The gonadal dose was found to depend on many physical factors and many factors of technique.

It was found that even with the milliampere-seconds (mas) and beam angle adjusted to compensate, a longer target-to-film distance resulted in greater exposure at a given point outside the main beam. It was found that skin dose, depth dose, and integral dose in the beam, in addition to scatter dose outside the beam, increase with increasing field size. The thickness of adjacent body parts affects the scatter dose—a protuberant abdomen increases the dose to the male gonad.

A 1 mm lead shield on a portable stand was found useful in reducing both male and female gonadal doses. The proper diaphragm with supplemental shielding can reduce these doses by a factor of 10.

Measurements made with a Victoreen 25 r thimble chamber or, for low doses, a Keleket pocket dosimeter, made possible the determination of milliroentgens of gonadal exposure per mas for typical diagnostic radiographic procedures. The product of these figures and representative values of mas formed a table of average male and female gonadal doses according to procedure. It is emphasized that these values, however useful for guidance, apply only to the department in which the measurements were made.

Armadillo: A Protective Clothing as a Shield from X-Radiation. J. M. Tanner,* R. H. Whitehouse, and J. H. Powell. Lancet 2:779 (Oct. 11) 1958. (*Institute of Child Health, University of London)

The protective device, christened "Armadillo", consists of a series of lead scales each sealed in a flexible plastic envelope, and arranged in overlapping rows. Used as clothing, it is about 95% effective in shielding male gonads from ordinary diagnostic x-rays, and is somewhat less effective in the female. Flexibility makes the device useful also as an apron for the operator.

Radiation Safety Evaluation of Fluoroscopes. J. Hale,* D. B. Kunsner, R. O. Gorson, and J. R. Bartsch. Radiology 71:227-235, (Aug.) 1958. (*Department of Radiology, Hospital of the University of Pennsylvania, Philadelphia 4)

The dose of ionizing radiation to the patient and operator during fluoroscopy depends on many factors. These can be conveniently divided into those inherent in the machine, such as exposure dose rate, radiation quality, and scatter, and those which depend on technique, such as time of exposure, diaphragm position, and body part. Measurements were made of primary and scattered radiation from a typical modern fluoroscope using a Victoreen 25-r condenser ionization chamber. Results are presented graphically. Scatter from the fluoroscopic screen has negligible effect on the dose rate measured at the table top if the screen to table distance is more than 15 cm. However, scatter from the table top results in significant deviation from the inverse square relationship when the chamber is within 10 cm.

The use of sufficient filtration of the beam is important in reducing exposures. Since it is frequently difficult to ascertain the equivalent filtration of the tube, table top, and accessory shields, the measurement of half-value layer (hvl.) is often a useful means of determining beam quality. The minimum acceptable hvl has been taken to be 2.5 mm of aluminum under normal operating conditions. An inferential measurement of hvl was made, using the Bakelite protective cover supplied with the chamber plus 0.010 inch of brass. For a given peak anode voltage, such a device can be calibrated to yield a figure of hvl calculated from readings made with and without the cover. Two determinations, therefore, will provide dose rate and hvl. Scattered radiation in the region of the operator can be reduced by shielding Bucky slots, and by the use of a shield curtain suspended from a fluoroscopic screen. In addition, the standard precautions recommended by National Bureau of Standards Handbook 60 should be employed. These cover such matters as the use of protective garments, adjustable diaphragm, cumulative exposure timer, and protective lead glass on the fluorescent screen.

Reparative Surgery

Joseph M. Dziob, M.D.

Reversibility of Pregangrene in the Severely Ischemic Limb. A. W. Humphries,* G. V. DeWolfe, and F. A. LeFevre. J. of Bone & Joint Surg. 40-A:983, 1958. (*Cleveland Clinic Foundation, Cleveland, Ohio)

The severely ischemic limb is manifested first by intermittent claudication; next by rest pain; and, finally, by ulceration or gangrenous changes. As regards treatment, three alternatives exist: arterial grafting, sympathectomy, and amputation. The choice depends on the nature of the occlusion: segmental or nonsegmental. In the case of segmental occlusion, primary arterial grafting is indicated; where the occlusion is nonsegmental, sympathectomy is preferred. The need for amputation represents a failure of either method. Arteriography has proved a relatively safe method of establishing the type of occlusion present. In those patients in whom sympathectomy was performed, pain was frequently relieved but some degree of claudication persisted in most cases. In the same group, it was necessary to perform amputation in 38% of cases. In those in whom arterial grafting was carried out, a high percentage were relieved of both the rest pain and the claudication and in only 12% was amputation required. It appears that the inevitability of amputation in the severely ischemic limb must be reevaluated in the light of the present practicability of arterial grafting.

Inguinal and Femoral Hernioplasty: The Evaluation of a Basic Concept. C. B. McVay,* and J. D. Chapp. Ann. Surg. 148:499, 1958. (*University of South Dakota School of Medical Sciences, Vermillion, S.D.)

This presentation is a statistical evaluation of a method of inguinal hernioplasty which is based on extensive anatomical studies of the inguinal region. According to the authors' concept, the posterior inguinal wall inserts into Cooper's ligament and has only a contiguous relationship to the inguinal ligament; therefore in repair of groin hernias that compromise the posterior inguinal wall (large indirect, direct, and femoral) Cooper's ligament should be used in the repair and not the inguinal ligament. The crux of the small indirect inguinal hernia problem is the size of the abdominal inguinal ring and not the length or size of the peritoneal sac. Most of these hernias need no more than high ligation and excision of the hernial sac with snug closure of the fascial abdominal ring by suturing the transversalis fascia to the anterior layer of the femoral sheath medial to the cord. A 1 to 11 year follow-up of 580 hernioplasties, of which 91% were reviewed, revealed a recurrence rate of 85 in 236 reconstructions of the posterior inguinal wall for difficult hernias. Less dramatic results were found in 344 abdominal inguinal ring repairs for simple indirect inguinal hernia, with a recurrence in 3.2%.

Management of Renal Injuries. J. H. DeWeerd.* J. Internat. Coll. Surg. 29:567, 1958. (*Mayo Clinic and Mayo Foundation, Rochester, Minn.)

In each case in which there is a history of trauma involving the lower thorax, the flank, or the upper abdomen, coupled with gross or microscopic hematuria, the possibility of renal injury must be considered. An excretory urogram should be performed, and this, together with the physical signs and laboratory studies, will indicate the proper therapeutic approach. Emergency cystoscopy and retrograde injection for a more detailed outline of the kidney is rarely indicated. Most kidney lesions may be treated conservatively, but occasionally surgical intervention is necessary to control continued grave hemorrhage and extravasation of urine. Apparently the injured kidney that requires immediate surgical intervention is beyond repair and therefore should be removed; the kidney that lends itself to repair probably would have healed without surgical intervention.

Nerve Injuries in the Upper Extremity. R. D. Larsen,* and J. L. Posh. A.M.A. Arch. Surg. 77: 469 (Oct.) 1958. (*Wayne State University School of Medicine, Detroit)

Larsen and Posh record their experience in the treatment of 325 cases of nerve injuries in the upper extremity. Diagnosis is established by testing the integrity of sensory and motor nerves in the hand. Care must be taken to avoid tension on the suture line. When the gap between the nerve ends cannot be overcome by dissection, repeated mobilization, and stretching, then nerve graft is necessary. The sural nerve is the donor nerve of choice. Immediate or primary repair of the nerve is favored whenever possible. In cases of contaminated, crushed, or torn wounds, secondary repair is preferred. Sensory return after nerve repair is uniformly good. Return of motor function, however, depends on the nerve involved, being most satisfactory after repair of the radial nerve and satisfactory in one-half to two-thirds of the cases of median nerve repair at the wrist. Motor return is uniformly unsatisfactory in ulnar nerve lacerations, regardless of where they are encountered. Where nerve function has failed to return, tendon transfer operations are available to restore function to the paralyzed portion of the extremity.

A Rapid Method of Skin Grafting Using the Brown-Berger Dermatome. C. R. Brown.* Am. J. Surg. 95:986, 1958. (*4510 West 4865 South, Salt Lake City)

This article on rapid skin grafting deals primarily with the recipient site. After the selection of a suitable donor site, the Brown-Berger electric clipper-like apparatus is adjusted so that the width of cut is ¼ inch beyond the edges of the wound. A thin layer of mineral oil is placed over the donor site and a section of split-thickness skin of that width and ¼ inch longer than the length of the wound is obtained by placing downward and forward pressure on the dermatome. The dermatone is then run over the granulation tissue of the wound in a similar fashion. Thus, the excess granulations are removed, leaving a smooth, clean bed for the donor skin of precisely the same dimensions. After oozing of the recipient site has stopped, the donor skin is laid over the defect. A strip of Telfa dressing slightly larger than the wound makes suturing unnecessary, although anchor sutures help to prevent slippage. The entire wound is then covered by a pressure dressing with Ace bandages or elastoplast and these are left undisturbed for about 10 days. A neat rectangular recipient site with little scarring is the usual result.

Clinical Toxicology

Lee H. Miller, M.D., I.M.D.

Boron Hydride (Borane) Intoxication in Man. H. J. Lowe* and G. Freeman. A.M.A. Arch. Indust. Health 16:523-533 (Dec.) 1957. (*National Cancer Institute, National Institutes of Health, Bethesda, Md.)

The effects on man produced by diborane, pentaborane, and decaborane are summarized from a study of the records of 83 persons who had been potentially exposed to boron hydrides. Thirteen persons were admitted to a hospital. Nine hospitalizations resulted from 14 instances of exposure to pentaborane, whereas 2 out of 38 persons exposed to diborane and 2 of 19 exposed to decaborane were hospitalized. The clinical records of the eight severest cases are described in detail. The boranes may be absorbed from either the respiratory system or the skin. The authors believe that the volatile nature of diborane is responsible for the high frequency of chest symptoms (tightness, cough) as the earliest evidence of exposure. On the other hand, penta- and decaborane first give rise

to dizziness, drowsiness, headache, followed by other central nervous system symptoms and signs which may include "jittery feelings," lack of coordination, muscle pains, tremors, involuntary muscle contractions, convulsions, confusion and inability to concentrate. All three, however, affect the nervous system eventually. Respiratory symptoms may also occur with exposure to the poorly volatilized higher boranes. Elevated nonprotein nitrogen values and liver function test abnormalities indicated that liver and kidney functions were altered. The cardiovascular abnormalities observed in severely poisoned animals were not detected. Various laboratory tests used for screening purposes were evaluated.

Aromatic Amines as Carcinogens in Industry. A. L. Walpole* and M. H. C. Williams. Brit. M. Bull. 14:141 (May), 1958. (*Imperial Chemical Industries Limited [Pharmaceuticals Division], Alderly Park, Macclesfield, Cheshire, England)

The authors review briefly chemicals in the dyestuffs industry and other industries that have been incriminated as etiologic agents in the production of bladder tumors. In man, auramine, 2-naphthylamine, benzidine, and 4-aminodiphenyl are believed to have produced bladder tumors. Tumors of this structure have been observed in men who were engaged in the manufacture of fuchsin (magenta); however, the specific etiologic agent has not been identified. Preliminary animal experimental results concerning the carcinogenic properties for a number of ring-substittued aminodiphenyls, diaminophenyls, aminostilbenes, and diaminostilbenes are given. The authors present the results with the hope that personnel who may contemplate using the compounds will employ appropriate precautions.

Anuria Due to Carbon Tetrachloride Intoxication. W. R. Guild,* J. V. Young, and J. P. Merrill. Int. Med. 48:1221, 1958. (*Peter Bent Brigham Hospital, 721 Huntington Ave., Boston 15)

This report is a clinical analysis of 20 patients with anuria due to CCl_4. Sixteen patients became intoxicated after inhaling the vapor, while the others were poisoned by the oral route. Eleven cases occurred as a result of cleaning furniture at home or machinery at work. The range of the exposure time was 30 minutes to 11 hours. Sixteen patients had consumed large quantities of alcohol daily for years, and, of these, fourteen had taken alcohol either shortly before, during, or after exposure to the agent. The earliest and commonest symptoms were nausea and vomiting. On the average, anuria developed three days after exposure and persisted for eight days. Twelve patients exhibited hemorrhagic phenomena, and fifteen had demonstrable liver damage. Hemodialysis was performed in 10 patients. Good biochemical responses occurred in all cases, and approximately 80% had a favorable clinical response. Indications for dialysis were severe potassium intoxication and central nervous system manifestations of the uremic syndrome. Five deaths occurred, and, in most cases, death was thought to be due to hepatic insufficiency. Two illustrative case reports are presented.

Silicosis of Ocher Workers: A Clinical and Anatomo-pathologic Study. A. D. Roche,* D. Picard, and A. Vernhes. Am. Rev. Tuberc. 77:839, 1958. (*Public Services of Vaucluse, France)

Ocher is an earthy, often impure ore of iron that is used as a pigment in varnish, lacquer, linoleum, and other products. It is mainly composed of silica and also contains a large proportion of iron.

Typical x-ray films and descriptions of the roentgenologic findings in 14 cases of ocher silicosis are presented, as well as the pathologic findings and results of chemical analyses of lung tissue from one case. Ocher silicosis presents unusual roentgenographic findings. Homogenous, well-defined, spherical or oval tumor masses surrounded by a layer of parenchyma are localized in the upper lobes. Emphysematous changes, similar to those seen in typical silicosis cases, are present in the bases. Nodular and confluent changes have been observed; however, the authors have never seen "snow-storm-like" pictures of the pseudogranulous aspect present in certain other types of silicosis. Hilar adenopathy and "egg shell" calcified nodes are found. On pathology examination, the center of the tumor was found to be liquified and the pleura was thickened. Tubercle bacilli were not found. From their findings, the authors conclude that ocher pneumoconiosis is a silica-siderosis.

Proteinuria in Chronic Cadmium Poisoning After Comparatively Short Exposure to Cadmium Dust. L. Friberg.* A.M.A. Arch. Indust. Health 16:30 (July), 1957. (*Institute of Hygiene, Karolinska Institutet, Stockholm, Sweden)

Friberg reports the cases of two men with comparatively short exposures to cadmium dust in whom proteinuria developed. The men were employed in making alkaline accumulations. In the first case, the exposure was over a period of seven years; however, the exposure during the last three or four years was considered to be of little significance. The proteinuria had not been discovered until three years after the patient had ceased handling cadmium. Unfortunately, a urinalysis had not been obtained at that time. The exposure in the second case occurred over a period of five years and was thought to be significant during the first and second years only. The possibility of symptoms of cadmium poisoning developing after exposure has ceased is pointed out. Because of this, the author believes that it seems reasonable to reexamine workmen who were formerly employed at jobs in which cadmium was used.

About the Authors

LLOYD E. HAMLIN, M.D., has been medical director of the American Brake Shoe Company since 1941. His paper in this issue, "Siderosis: Observations over a Period of Eight Years," is the most recent of a series of thirty-odd on the subject of occupational diseases of the chest. Dr. Hamlin's original training was in surgery. After graduating in medicine from the University of Toronto in 1922, he interned and then served a residency in surgery at Henry Ford Hospital in Detroit. In 1925 he became physician in charge of medical service for the Ford Motor Company's upper Michigan operations, and was based at Iron Mountain, Mich. In 1929 he shifted his affiliation to the Penn Iron Mining Company, Norway, Mich., and in this connection started an enduring interest in the pneumoconioses. Dr. Hamlin's medical program at "Brake Shoe" provides industrial nursing, industrial hygiene, and medical services to some 10,000 employees in 55 plants at 23 different locations throughout the United States and Canada. Under Dr. Hamlin's direction, his company supported, at Saranac Laboratory, experimental investigations of biologic response induced by dust generated during foundry cleaning room operations. The results of these studies provide a part of the material upon which Dr. Hamlin's present paper is based. Dr. Hamlin is a past director of the Industrial Medical Association, and has been an active member of various IMA committees. His activities in other organizations have been in the general field of occupational medicine, with emphasis upon occupational diseases of the chest.

ALLAN J. FLEMING, M.D., medical director of the duPont Company, has worked in industrial medicine since 1935. He was born in Winnipeg, Manitoba, Canada, July 23, 1901, and received his bachelor and master of science degrees at the University of Manitoba. He graduated in medicine at McGill University in 1932. After two years as plant physician at the Beloeil Plant of Canadian Industries Limited at McMasterville, Quebec, Dr. Fleming joined duPont in 1937 as a toxicologist in the Haskell Laboratory for Toxicology and Industrial Medicine. The laboratory is devoted to research work on potential industrial hazards associated with duPont products and processes. In 1941 he was made assistant director of the Haskell Laboratory, and in 1948 was appointed assistant director of the company's medical division. He was advanced to director of the division in September 1954. Dr. Fleming has written a number of articles for medical and technical publications. He is also co-editor, along with Dr. C. A. D'Alonzo and Dr. John Zapp, of the duPont Company, of a book, "Modern Occupational Medicine," published in September, 1954. Among medical societies of which he is a fellow are the Industrial Medical Association, American Medical Association, American Academy of Occupational Medicine (of which he was president in 1954), and the American College of Physicians (Associate). He is certified by the American Board of Preventive Medicine in Occupational Medicine. He was an active member of the Wilmington Symphony Orchestra for many years and was president of the organization in 1949 and 1952.

MR. EDWIN J. HOLMAN, a lawyer, is author of the article in this issue entitled "Medical Professional Liability: Result of National Survey." This is a paper he presented at the May, 1958, meeting of Central States Society of Industrial Medicine and Surgery. Mr. Holman, a native of Kansas, graduated cum laude from the University of Notre Dame with the bachelor of arts degree in 1934 and three years later received the bachelor of laws degree from the University of Kansas. He practiced law in Leavenworth, Kansas, from 1937 through 1947, during which period he also served two terms in the Kansas legislature. He has had two tours of active duty in the United States Navy: one during World War II and the other during the Korean incident. In 1947 Mr. Holman joined the law department of the American Medical Association. He is executive secretary of that Association's Judicial Council. Mr. Holman is a member of the Kansas and Illinois bars, the Illinois Bar Association, the American Bar Association, and the American Academy of Forensic Sciences. Other published papers by Mr. Holman include "Medicolegal Aspects of Sterilization, Artificial Insemination and Abortion" (J.A.M.A. 156: 1309, 1954); "Legal Aspects of Patent Photography" (Journal Biographical Photographic Association [Nov.] 1950); "Voluntary Health Insurance in the United States" (Iowa Law Review, Vol. 35, 1950 [co-author]); and A Guide to Hospital Records (Defense Law Journal, Vol. 3, 1958).

BROOKE ROBERTS, M.D., is assistant professor of surgery at the School of Medicine, the University of Pennsylvania. His paper in this issue, Major Blood Vessel Surgery for Traumatic Injury was presented at the IMA's annual meeting in Atlantic City in April, 1958. Dr. Roberts completed his undergraduate work at Princeton University in 1939 and received his medical degree from the University of Pennsylvania in 1943. This was followed by a rotating internship, two years in the Army, and then a four years' residency in surgery at the Hospital of the University of Pennsylvania. A part of this time was spent in a concurrent appointment as a fellow in the Harrison Department of Surgical Research. Dr. Roberts was certified by the American Board of Surgery in 1951. His special areas of interest are suggested by memberships in the American Association for Surgery of Trauma,

Physiological Society of Philadelphia, and the Society of Vascular Surgery. Besides his position in the School of Medicine, Dr. Roberts is Associate in Surgery at the Graduate School of Medicine of his University. His hospital appointments are at the Hospital of the University of Pennsylvania and the Veterans Administration Hospital in Philadelphia.

EDWARD V. HENSON, M.D., is medical director of the South Charleston (West Virginia) operations of Union Carbide Chemicals Company. This is a complex of research and development laboratories, engineering groups, pilot plants, and production units devoted to the synthesis of a long list of organic chemicals from simple olefinic hydrocarbons. The plant industrial hygiene and the medical control programs at these operations provide a major portion of the running experience from which to plan and interpret an extensive toxicology research program supported at Mellon Institute by the Carbide Company. From this unusual background of theory, experiment, and practice, Dr. Henson will present a series of topical reviews in this journal on the toxicology of organic chemicals. The first of these appears in the present issue under the title "Toxicology of Some Aliphatic and Alicyslic Hydrocarbon Compounds." Dr. Henson is a native of Pennsylvania. He graduated from the School of Chemistry at Pennsylvania State College in 1939 and from Jefferson Medical College in 1943. After an internship at Jefferson Hospital in Philadelphia, he served in the U. S. Army as a medical officer in the Pacific Theatre. Thereafter he was general resident at St. Francis Hospital, Charleston, W. Va. until he joined the medical staff at the Carbide operations in South Charleston. He became head of his department in 1950. Dr. Henson is a member of the Editorial Board of this Journal.

NIEL WALD, M.D., in this issue presents the first of 12 parts of a topical review on radiation medicine. Dr. Wald is currently associate research professor of radiation health in the department of occupational health at the School of Public Health and assistant professor of medicine at the School of Medicine, the University of Pittsburgh. In the department of occupational health he heads a program for training physicians, health physicists, and related personnel in the new field of radiation health. This program is supported for 10 years by a grant from the Rockefeller Foundation and will utilize the resources of the expanding University Health Center as well as the nuclear engineering industry and the reactors immediately available in the Pittsburgh area. Dr Wald received the A.B. degree from Columbia (University) College, and the M.D. degree from New York University in 1948. He trained in internal medicine at hospitals in New York City, giving emphasis to the subspecialty of immunohematology. During a tour of extended active duty with the United States Air Force Medical Corps he was assigned to the department of radiobiology at the School of Aviation Medicine, Randolph Air Force Base, Texas, where he participated in various research projects dealing with the biological and medical effects of ionizing radiation. These included joint studies with the Atomic Energy Commission's Nevada Proving Grounds, Oak Ridge National Laboratory, Los Alamos Scientific Laboratory, University of Texas-U.S.A.F. Radiobiology Laboratory in Austin, and the University of Texas M. D. Anderson Hospital in Houston. In 1954 Dr. Wald joined the internal medicine department of the National Academy of Sciences-National Research Council's Atomic Bomb Casualty Commission in Hiroshima, Japan, as senior hematologist. Until early 1957 he conducted a leukemia case-finding and therapy program and investigated anemia in the Hiroshima population. After his return to the United States, Dr. Wald joined the Health Physics Division of Oak Ridge National Laboratory and participated in its atomic bomb dosimetry studies in Oak Ridge and the Nevada Test Site. He continues as consultant hematologist to the NAS-NRC's Japanese studies and as a consultant in atomic bomb research and other projects of the Health Physics Division, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

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People and Events

► HOWARD A. RUSK, M.D., Director of the Institute of Physical Medicine and Rehabilitation, New York City, is recipient of the 1958 Physician's Award presented annually by the President's Committee on Employment of the Physically Handicapped to a physician who has made an outstanding contribution to the national program to widen job opportunity for physically impaired workers.

DR. RUSK received the illuminated plaque signed by the President of the United States at the banquet of the 19th annual Congress of Industrial Health at the Netherland Hilton Hotel in Cincinnati, February 16.

For many years DR. RUSK has been prominent in the field of rehabilitation and physical medicine. He is also Chairman of the Department of Physical Medicine and Rehabilitation at New York University - Bellevue Medical Center. DR. RUSK has been a liberal contributor to national magazines on subjects dealing with the restoration of physically handicapped men and women to useful lives in the labor force. He is an associate editor of the *New York Times* and writes a weekly column on subjects pertaining to handicapped workers.

He is a frequent speaker on national television shows and in June, 1958, was the main speaker at the International Labor Organization Conference in Geneva, Switzerland. He has appeared on many programs with MAJ. GEN. MELVIN J. MAAS, Chairman of the President's Committee.

DR. RUSK received his M.D. degree in 1925 from the University of Pennsylvania. From 1926 to 1942 he practiced internal medicine in St. Louis, where he was an instructor at Washington University School of Medicine. During World War II he served as a colonel in the Medical Corps of the Army Air Force and originated and directed the Air Force's convalescent rehabilitation training program for which he was awarded the Distinguished Service Medal. He is currently a Brigadier General in the Air Force Reserve.

In 1957, DR. RUSK received a Citation for Meritorious Service from the President's Committee. He was recommended for the Physician's Award by DAVID H. GOLDSTEIN, M.D., President, The New York State Society of Industrial Medicine and by the New York Governor's Committee on Employ the Physically Handicapped, ORIN LEHMAN, Chairman.

Howard A. Rusk, M.D.

C. H. Baylor, M.D.

DR. RUSK is a member of the INDUSTRIAL MEDICAL ASSOCIATION, the American Medical Association, the American College of Physicians and the American College of Physical Medicine.

► JOHN R. PEFFER, M.D., has been appointed Chief of Medical Services for the American Steel and Wire Division of United States Steel Corporation in Worcester, Massachusetts. He has been Medical Examiner for Timken Roller Bearing Company in Canton, Ohio, since 1947.

DR. PEFFER graduated from Loyola University in Chicago in 1935 and obtained his M.D. degree there in 1937. He interned at St. Anne's Hospital in Chicago and was Medical Resident at Cook County Hospital from 1940 to 1943. Following three and a half years as Flight Surgeon with the United States Army Air Force, he was research fellow at Hektoen Institute in Chicago from 1946 to 1947.

► C. H. BAYLOR, M.D., has been appointed Medical Director of The Texas Company, New York City. He will be in charge of the Health Division of Texaco's Industrial and Public Relations Department, directing the medical programs of the Company and its subsidiaries. He succeeds MELVIN N. NEWQUIST, M.D., Medical Director since 1940, who retired January 1.

DR. NEWQUIST received his M.D. degree from the University of Nebraska College of Medicine, 1924, and served his internship at the University of Nebraska Hospital. He was in general practice in Bloomfield, Nebraska, from 1925 to 1929, and did postgraduate work in surgery in Chicago in 1930. He was field representative and later Assistant Director of the American College of Surgeons from 1931 to 1939, engaged principally in making industrial surveys of medical services.

DR. NEWQUIST is a member of the medical advisory commissions of the National Association of Manufacturers and the American Petroleum Institute. He is also Associate Clinical Professor of Industrial Medicine at New York University, and Visiting Lecturer in Industrial Hygiene at Harvard University, School of Public Health. He is a Fellow and past-president of the Industrial Medical Association (1945-46), a Fellow of the American College of Surgeons and the American Medical Association. He is author of "Medical Service in Industry and Workmen's Compensation Laws," first published in 1934, and revised in 1938.

DR. BAYLOR graduated from Emory and Henry College in 1929 with a B.S. degree, and received his M.D. degree from The Johns Hopkins University in 1935. Following service on the house staff of Strong Memorial Hospital in Rochester, New York, he became a professor of internal medicine at the American University of Beirut in Lebanon in 1938. He remained in that position until 1949, when he joined Texaco as Assistant Medical Director.

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S. D. Steiner, M.D.

► Succeeding MAX R. BURNELL, M.D., as Medical Director of General Motors Corporation is S. D. STEINER, M.D., who has been Medical Director of the Oldsmobile Division of General Motors in Lansing, Michigan, since 1946. DR. BURNELL retired November 1, 1958, after ten years as head of General Motor's medical department.

DR. STEINER received his M.D. degree from Northwestern University Medical School in 1937. After his internship at University Hospital in Pittsburgh, he became Public Health Officer of Brooke County, West Virginia. In 1939, he entered Harvard University on a Rockefeller Foundation Scholarship, and received his master's degree in public health in 1940.

He served for a short time with the Division of Industrial Hygiene of the U.S. Public Health Service, and in 1942, became associated with the Industrial Hygiene Division of the Maryland State Health Department, remaining there until 1944 when he joined the Cadillac Motor Car Division of GM as Plant Physician. A year later, he went to Oldsmobile in the same capacity, and became Medical Director of Oldsmobile a year later.

DR. STEINER has been certified by the American Board of Preventive Medicine in Occupational Medicine. He is a Fellow of the INDUSTRIAL MEDICAL ASSOCIATION, and a member of the American Academy of Occupational Medicine.

► HARWOOD S. BELDING, PH.D., professor of environmental physiology in the Department of Occupational Health, Graduate School of Public Health, University of Pittsburgh, is to be the United States representative at an International Conference on The Human Sciences and Their Application in Industry. The conference, to be held March 2-5 in Zurich, Switzerland, will be attended by 150 key representatives of management, labor and science.

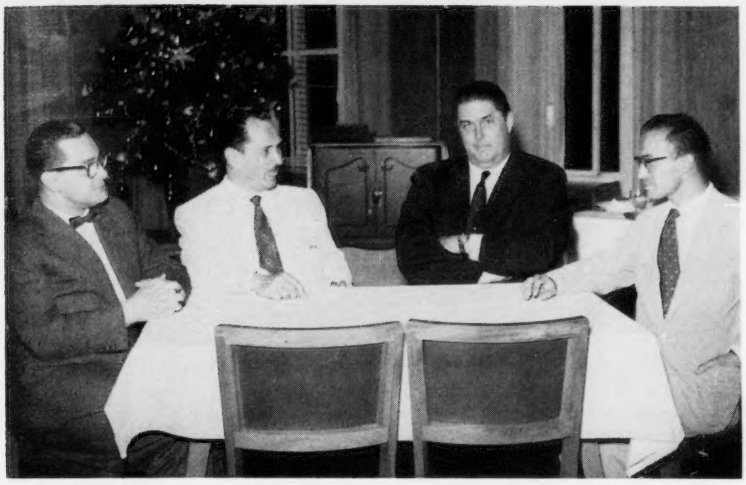
The activity is an outgrowth of a project entitled "Fitting the Job to the Worker," jointly sponsored by the European Productivity Agency and the International Cooperation Administration, for which DR. BELDING was the U.S. adviser. In 1956 he selected a multi-disciplinary team of nine specialists representing seven Western European countries, and organized a two-month course for them in the United States. In this country, the team studied technical means utilized for arrangement of industrial jobs to utilize the worker's capabilities without subjecting him to unnecessary or harmful strains. Among topics considered were the design of controls and indicators on machines and control of such environmental factors as heat, noise, dust and light.

► The American College of Chest Physicians will hold its silver anniversary meeting at the Ambassador Hotel, Atlantic City, June 3-7, 1959. The scientific program will include prominent speakers on all aspects of heart and lung diseases. In addition to formal presentations, there will be a number of symposia, round table luncheon discussions, postgraduate seminars, and motion pictures. More than 60 experts in chest disease will participate in Fireside Conferences, a feature inaugurated in 1955 for the discussion of topics of current interest.

Examinations for Fellowship in the College will be held Thursday, June 4. At the Convocation on the evening of June 4, more than 200 new Fellows will receive their certificates of Fellowship. The President's banquet and annual dance will be held Saturday, June 6.

DR. DONALD R. MCKAY, Buffalo, New York, President of the College, has announced that to commemorate the Silver Anniversary, the College is publishing a history of the growth of the organization since its first meeting in 1935.

► "The Health of People Who Work" is the theme of the 1959 National Health Forum to be held at the Palmer House in Chicago, March 17-19. The meeting is designed to focus nationwide attention on occupational health problems and needs. It will bring together leaders in management, labor and community planning, as



On a recent trip to Brazil, Dr. Logan T. Robertson, M.D., (third from the left) met with the industrial physicians of Sao Paulo, one of the fastest growing industrial cities of the world. Pictured above are (left to right): Dr. Mario Braz, Medical Director, CIA Antarctica Paulista Brewery; Dr. J. A. Junquiera, Standard Oil of Brazil; and Dr. Bernardo Bedrikow, head of the Industrial Medical Section of SESI, an employers' association.

well as the health professions and voluntary and official health agencies.

The Forum is sponsored by the 64 member agencies of the National Health Council. NORVIN C. KIEFER, M.D., is President of the National Health Council; JAMES H. STERNER, M.D., Medical Director, Eastman Kodak Company, Rochester, New York, is chairman of the planning committee.

One of the principal speakers will be DR. ARTHUR S. FLEMMING, Secretary of the Department of Health, Education and Welfare. At the opening session, speakers will summarize the occupational health problems as seen by management, labor, and other groups concerned, setting the stage for the 20 panel discussion meetings which are designed to identify and stimulate action for improvement in preventive health services for people who work.

Although the conference will be considering many phases of the health of workers, their families, and their environment, it will put major emphasis on occupational health services in the small plant. Problem areas to be discussed include: Costs of Occupational Health Programs; Staffing Occupational Health Services; Rehabilitation and Job Placement; Mental Health; Communications; Environment; Health Education; Safety In and Out of Plants; Mobilization of Community Resources; Research, Studies and Statistics.

► Texas Industrial Medical Association will hold its annual meeting at the Hilton Hotel in San Antonio on April 19. The Texas IMA is combining its scientific program with that of the Texas Traumatic Surgical Society. Both will meet as related groups with the Texas Medical Association at its annual convention.

Guest speakers will be JACK R. EWALT, M.D., Commissioner of Mental Health for the Commonwealth of Massachusetts, who will discuss "Psychiatry in Industry"; and KENNETH W. WARREN, M.D., surgeon, Lahey Clinic, Boston, whose subject will be "Surgical Management of Benign Pancreatic Disease."

Other presentations will be as follows: "Some Ethical Aspects of the Private Practice of Industrial Medicine in Texas"—W. H. HAMRICK, M.D., President, Texas IMA; "Surgical Management of Benign Pancreatic Disease" — JESSE E. THOMPSON, M.D.; "Diagnosis, Surgical Management and Prognosis for Industrial Rehabilitation in Herniated Lumbar Discs" — F. KEITH BRADFORD, M.D.; and "Complications of Diaphragmatic Hernia"— G. V. BRINDLEY JR., M.D., President, Texas Traumatic Surgical Society.

► The Mid-Winter meeting of the Western New York Society of Industrial Medicine and Surgery was held February 7 at the Manager Hotel in Rochester, New York.

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Presentations on the scientific program were "Skin Pigmentation: Use of Skin Reflectance (Spectrophotometer) as a Diagnostic Procedure" by WILLIAM R. BUCKLEY, M.D., Dermatologist, Eastman Kodak Company; "Pneumoconiosis" by NOLAN L. KALTREIDER, M.D., Professor of Medicine, University of Rochester School of Medicine and Dentistry; and "Effects of Fluorides in Man" by HAROLD C. HODGE, Ph.D., Professor of Pharmacology and Radiation Biology, University of Rochester School of Medicine and Dentistry. The scientific program was followed by the annual business meeting and election of officers.

► "Hand Injuries in Industry" was the subject covered by two speakers at a meeting of the Industrial Medical Association of Philadelphia at the Penn Sherwood Hotel on January 28. The speakers were Stephen A. Christides, M.D., orthopedist, and Richard S. Oakey Jr., M.D., plastic surgeon.

► Five Americans will participate in the International Symposium on Maximum Allowable Concentrations of Toxic Substances in Industry to be held in Prague, Czechoslovakia, April 14-17. It is the purpose of the Symposium to evaluate the possibility of introducing maximum allowable concentrations on an international basis, and to elaborate suitable suggestions.

After an investigation of present definitions and concepts of maximum allowable concentrations in different countries, reports will be given on the evaluation of present methods and procedures used in different countries for the determination and fixing of maximum allowable concentrations. At this session, ROBERT A. KEHOE, M.D., of the University of Cincinnati's Kettering Laboratory, will present a communication. Communications for this discussion will be sent by W. B. DEICHMAN, Ph.D., of the Department of Pharmacology, University of Miami School of Medicine, and W. F. VON OETTINGEN, M.D., of the National Institutes of Health, Bethesda.

A discussion on maximum allowable concentrations in biological materials will include a presentation by HERVEY B. ELKINS, Ph.D., of the Massachusetts Division of Occupational Hygiene, Boston. A session on April 16 will consider the importance of suitable methods of chemical analyses, physical methods of sampling used in industry. WILLIAM P. YANT, Sc.D., of the Mine Safety Appliances Company, Pittsburgh, will present a communication at this meeting.

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